TECHNOLOGY DEPT:

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American Foundryman

January 1945

R v. 7-8 1945

A Plea for Continued Support By the Brass and Bronze Div. To Insure Post-War Progress

THIS plea is directed to Chapter Officers, Foundry Executives and Managers, especially those whose operations fall within the manufacture of brass and bronze castings.

Since assuming Chairmanship of the Brass and Bronze Division of the American Foundrymen's Association, the LACK of the necessary personnel for committee work, as well as authors of papers for program activities, has been forcibly brought to my attention. I am sure this is not due to lack of interest on the part of the members of the American Foundrymen's Association, but to the inability of these prospective authors to come to the attention of the proper forces.

Therefore, I think it is the duty of all Chapter Officers, Foundry Executives and Managers to insist that the outstanding men in their Chapters and Companies be proposed for committee work, as well as for prospective papers for convention purposes.

It would be appreciated if the above mentioned individuals would take it upon themselves to forward to me the names of the outstanding men in their Chapters and Companies, especially the younger men engaged in brass and bronze foundry practices, so that we may be able to carry on the fundamental aims of the A.F.A.—"To promote the arts and sciences practiced or applied by foundry operators."

My plea for the younger men is paramount because we must at all times have an eye to the future and have someone available to carry on when the old guard has passed along. Technically trained as well as practical foundrymen should be encouraged to actively participate in the doings of the Brass and Bronze Division.

If the Brass and Bronze Foundry Industry is to compete with other industries during the months ahead, it will have to depend largely on the technical advancements the industry makes, which requires constant development and distribution of information on the betterments of method and product, as we well know that "The one guiding principle of A.F.A. that has remained unchanged is that the American Foundrymen's Association is and shall continue to be a service organization."

B. A. Miller

B. A. MILLER, *Chairman*
A.F.A. Brass and Bronze Division

B. A. MILLER, Chief Metallurgist, Baldwin Locomotive Works, Cramp Brass & Iron Foundries Div., has served the Association through his chapter and committee work, and by the technical papers he has presented before A.F.A. meetings. At present, in addition to his activities as Chairman of the Brass and Bronze Division, Mr. Miller is serving as a director of the Philadelphia Chapter.

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IMPROVEMENTS
In Static Ferrous Castings
INFLUENCING THEIR FUTURE USE

Although in the past castings have been used in the automotive and related industries, their adoption for highly stressed parts has been limited, due, largely, to a lack of uniformity in quality. This paper, presented at the National War Material Meeting of the Society of Automotive Engineers, in Detroit, June 5-7, 1944, deals with the recent developments and improvements relating to static ferrous castings, which should have a beneficial effect upon their future use as an engineering material.

By G. Vennerholm
Ford Motor Co.
Dearborn, Mich.

SINCE the beginning of the rearmament program the foundry industry has not only done a remarkable job in increasing its output of castings, but it also has undergone a very gratifying expansion of its field of activity, which is bound to have a considerable effect on future engineering designs.

This is best evidenced by the great variety of new parts, formerly made by other methods of manufacture, which are today being cast. Included in these are items ranging all the way from guns, armor castings, and projectiles to component parts going into highly stressed engineering assemblies for aircraft, tanks and armored cars, naval ordnance parts, etc.

The primary reason for this rather unconventional departure of the foundry from its formerly more or less accepted field of activity was no doubt, at least in the beginning, the great shortage of equipment and manufacturing facilities in the forging industry, compelling the designers to turn to castings. Today we believe, however, that the foundries in the majority of cases have proved themselves fully capable of successfully solving the problems which they have had to attack.

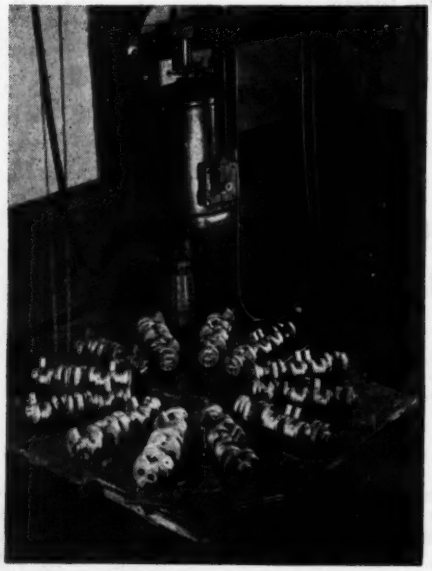


Fig. 1—Million volt X-ray machine in Ford Motor Co. steel foundry.

Impact Resistance

Perhaps no other type of casting, in the development of which a considerable number of foundries have taken part, produced greater problems than the armor casting. Not only were there no available standards, covering chemical composition or physical requirements, but the conventional methods of testing, as used in the past, did not prove a satisfactory indicator in judging the behavior and qualities of this type of casting.

The acceptance test by the armed forces is based on ballistic performance both at normal and sub-zero temperatures, which means that the castings have to withstand terrific impact in the form of actual projectiles. In addition to these high "resistance to ballistic impact" requirements, the compositions must be such as to make the material readily weldable as a large number of these castings are welded into assemblies and, in addition, later may have to be repaired by welding in the field.

Early compositions developed were rather high in alloy content, following the practice used for rolled armor in World War I. Shortage of strategic alloys, however, soon made this practice prohibitive, and today these same castings are made with comparatively small amounts of alloys and meet requirements above those of 3 years ago.

The development of cast armor is rather typical of the new problems which have confronted the foundry industry as a result of the present emergency. The extensive research which underlies these new developments has resulted not only in the satisfactory solution of many difficult assignments vital to the war effort but, what is probably more important, it has broadened the knowledge and increased the understanding and appreciation of the importance of scientific methods in the melting, casting, and heat treating technique. This, coupled with improved methods of process control and inspection, should have a very beneficial effect on the quality as well as increasing the field of potential utilization of castings.

Improved Materials Procedures

Without attempting to go into technical details, we shall describe what we believe to be the improvements which will have the greatest influence on strength and quality of castings.

Although malleable and gray iron castings cannot be left out of a discussion of this type, we believe that the greatest change has taken place in the steel foundries and we shall, therefore, direct most of our attention to this type of product.

Factors Affecting Quality and Uniformity

The equipment used in melting the materials, in particular steel, has not been altered to any considerable

extent, with the exception of greater utilization of duplex and triplex systems incorporating the bessemer converter in order to facilitate meeting the greater tonnage requirements.

As a result of research necessitated by the ever increasing requirements in mechanical properties and the, consequently, better understanding of the detrimental effect of occluded gases, inclusions, etc., greater care is exercised today in the proper refining of the molten metal through careful control of the boil, recarburization, deoxidation and slag, thereby greatly improving the quality of the steel. It is of interest to note that not many years ago this practice of complete boil and recarburization was considered unorthodox for acid furnaces.

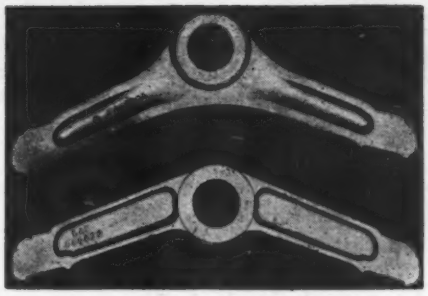


Fig. 2—Old (a) and new (b) design cast tank bogey lever.

The increased use of the spectrograph and similar rapid analytical methods allows the foundry metallurgist an accurate knowledge of the composition of the molten metal at all times, making it possible to manufacture to closer limits.

New types of hardeners and deoxidizers have been developed, which aid in the control of hardenability, grain size, and inclusions, thereby helping to make better castings.

Perhaps the most important gain, however, to the user of castings is the uniformity in the product which has been achieved through these developments.

Improvements in Soundness

The earnest effort of the casting manufacturers to meet the increased demands, coupled with the compulsory introduction of X-ray and

Table I

CAST STEEL ANALYSIS CHART

Type	*Parts*	*C*	*Mn*	*Si*	*P*	*S*	*Cr*	*Mo*	*Cu*	*Misc.*	*Heat Treatment and Hardness*
F-1035	General Purpose Steel and Ordnance Castings	.30-.40	60-.85	25-.45	.05 max.	.05 max.					1750° F. Normalize 1350° F. Draw Brinell Hardness 140-179
F-1041 (No. 4)	Passenger, Tractor and Ordnance Castings	38-.45	.70-.90	.15-.40	.05 max	.05 max			50-.60		Anneal to Brinell 163-207 Or Water Quench and draw to specified Hardness
F-1041X (No. 4X)	Truck, Tractor and Ordnance Castings	.38-45	1.30-1.60	.15-.40	.05 max.	.09-.12					Normalize to Brinell as Specified
F-4040X	Sprockets, Flywheels and Spindles	.35-.45	.90-1.10	.20-.40	05 max.	.05 max.		20-.30			Heat Treat to Specified Hardness Brinell
F-4041 No. 4Mo	Ordnance Castings	.38-.45	.70-.90	.15-.40	.05 max.	.05 max.		20-.30	.50-.60		Normalize, Quench and draw to specified Brinell Hardness
F-4122 (No. 2)	Truck Ring Gears and Parts to be Carburized	.20-.25	.40-.55	.20-.40	.04 max.	.03 max.	.65-.75	.25-.35			Normalize, Carburize and Direct Quench—or Reheat and Oil Quench and Draw to Rockwell "C" 58-62
F-4134 (No. 3)	Centrifugal Castings—Transmission Counter-Shaft & Diff. Ring Gear	.30-.38	.55-.75	.20-.40	.04 max.	.03 max.	.80-1.10	.10-.20			Normalize to Brinell of 170-196 Harden Gears as per Print
F-4140	Centrifugal Castings Cylinder Barrels Bomber Parts	.35-.45	.60-.90	.45-.65	.02 max. Desired 025 max	025 max	.80-1.10	.15-.25			Normalize to Brinell of 170-196 Harden to 286-321 Brinell
F-4145 (No. 3D)	Cast Steel Dies and Die Blocks	42-.47	.65-.75	.20-.40	.04 max.	.03 max.	.90-1.10	.30-.40			
F-4357 (No. 5M)	Special Crankshafts	.55-.60	.60-.80	.30-.40	.05 max.	.05 max.	1.00-1.25	90-1.10	70-1.00	Nickel .55-.65	Normalize 1950° F. 5 hours, Air Cool. Reheat to 1600° F. Cool in still air. Draw 1150° F. to meet B. H. of 302-341.
No. 6	Miscellaneous Castings	.80-1.00	.50-.70	1.20-1.40	.06 max.	.06 max		.15-.25			Soak at 1720° F. 1½ hours. Cool rapidly to a min. of 1200° F. Reheat to 1440° F. and hold 30 min. Drop to 1350° F. in 1½ hours. Hold at 1350° F. 3½ hours. Cool to 1200° F. in 1½ hours Air Cool. B. H. 197-255.
No. 8	Crankshafts	1.35-1.60	.70-.90	.85-1.10	.10 max.	.08 max	.40-.50		1.50-2.00		1750° F. 45 min. Air Cool to a max. of 1200° F. Reheat to 1400° F. hold 1 hour. Furnace Cool to 1000° F. B.H. 241-286.
No. 9	Pistons	1.40-1.60	.80-1.00	.90-1.10	.10 max.	.08 max	.15-.20		2.00-2.30		1650° F. 20 min. Air Cool to a max. of 1200° F. Reheat to 1400° F. Hold 1 hr. Furnace cool to 1000° F. B.H. 190-228.
	Valve Insert No. 1	1.20-1.40	.30-.50	.30-.60			3.00-4.00	8.0-9.0	1.50-2.00	Tungsten 1.75-2.25	1450° F. 30 min. Cool in 3 hrs to 1000° F. Rock. "C" 38-46.
	Valve Insert No. 2	1.20-1.40	.30-.50	.30-.60			2.50-3.50		1.50-2.00	Tungsten 14.0-17.0	(Same as No. 1)
	Valve No. 1	.95-1.20	.20-.30	2.0-3.5			15.0-16.0			Nickel 14.0-15.0	
	Valve No. 2	1.00-1.20	.30-.50	2.5-3.5	.05 max.	.05 max.	19.0-21.0		1.50-2.00		
	Valve No. 3	.40-.50	.20-.60	3.0-3.5	.025 max	.025 max	8.5-9.5				

other methods of inspection, in particular in connection with ordnance and aircraft work, has led to profitable studies relating to internal stresses, mass effects and other factors having a direct bearing upon the soundness of the casting. These studies have resulted in a better understanding of design factors and many improvements in the methods of gating and risering.

Other significant developments have thrown new light on the effect of mold gases on casting and, as a result, have brought forth new mold materials as well as improved methods of sand control.

Unfortunately, we still have to face the fact that when metals solidify they contract and, at the same time, that the cooling starts at the surface and progresses towards the center of the object. Unless precautions are taken to supply additional metal in the proper place to offset this condition, shrinkage cavities will occur.

We shall attempt, a little later, to show that if certain fundamental principles are followed when designing parts to be cast, some of the difficulties in obtaining sound castings can be eliminated.

New Steels

The improvements accomplished in the making of the steel and in the foundry technique have in addition been supplemented by the increased use of alloys.

Prior to the war the majority of cast steels were either plain carbon or of relatively low alloy content, mainly of the manganese type.

The substitution of castings for many forgings and fabricated assemblies, however, has led to the adoption of many of the forging steels by the foundry industry. In addition, copper bearing and high carbon steels which, due to their limited forgeability, found few applications in the wrought steel industry are rapidly becoming important cast steels.

The general tendency appears to be toward standardization of cast steels along the lines of the N. E. steels, and it is not unlikely that within a year or so standard N. E. compositions for cast steels will be in use.

The cast steel analysis chart (Table I) from the Ford Motor Co. foundry may be of interest, as it indicates the variety of steels used to meet varying requirements.

Higher Strength Through Heat Treatments

The wider application of castings for highly stressed parts, requiring properties unobtainable through the earlier heat treatments, has been made possible through the increased use of liquid quenching. This advancement, although by no means new in the foundry industry, has brought about a better realization of the importance of the hardenability factor as an indicator of how the material will respond to heat treatment.

Many foundries today are using hardenability tests as part of their routine testing. This, no doubt, is a step in the right direction and follows the trend in the rest of the steel industry, which now realizes that chemical analysis, as an indicator of potential properties, is of secondary importance. The results

Fig. 3—Cast fan shroud for medium tank.

Fig. 4—75 mm. gun recoil cylinder cast design.

obtained in the foundry industry through the adaptation of these newer methods are indeed encouraging.

It may be of interest to those not familiar with steel castings to examine some of the specifications which today form the minimum requirements for the products of many foundries (Table II).

It will be noted that two values are given for elongation and reduction of area. The higher values represent the original specification which had to be revised as a result of the curtailment in amount of strategic alloys allowed for castings.

The utilization of flame, induction and other selective or differential hardening methods have made it possible to adopt castings for many parts that formerly were made by other methods. (Figs. 6 and 7).

Improved Testing and Inspection

Determination of Properties

The conventional test bar and the results obtained therefrom today still forms the basis for judging many steel castings. The realization, however, that the test bar alone is not a satisfactory means of judging the quality of a casting is gaining ground. The information obtained from the test bar forms a basis for judging the quality of the particular batch of steel represented and its response to a particular heat treatment, but is no guarantee that the castings made therefrom are satisfactory.

For practical reasons the test bar is cast either as a separate coupon or as an appendix attached to the

Table 2

PHYSICAL REQUIREMENTS ACCORDING TO QQS681B

Class of Casting	Yield Point, psi.	Tensile Strength, psi.	Elongation, per cent in 2 in.*	Reduction of Area, per cent*
4C2	85,000	105,000	18 15	40 30
4C3	100,000	120,000	14 12	35 30
4C4	125,000	150,000	10	25
Physical Requirements for Certain AircraftCastings....		180,000	8	

* Minimum.

casting, and it must, in order to serve its purpose, be made as sound as is possible. This results in casting methods which cannot be economically duplicated for the casting which it represents.

The generally conceded inadequacy of the above tests has led to the wider application of actual load tests as a means of inspection. These tests consist of loading the castings to a predetermined limit, in a manner that will produce stresses similar to service conditions, and may consist of impact, static or dynamic loading. The extent of testing may be limited to spot checking, or when deemed necessary it may be used 100 per cent.

An additional test supplementing those just described has been recently adopted by the army ordnance department, as part of their specification covering certain steel castings. This test, generally termed "fiber test," requires that a sample consisting of a test lug, attached either to the casting or cast as a separate coupon and representing the average thickness of the casting, be fractured after receiving the same heat treatment as the casting.

The fracture must have a fibrous character and be free from any crystalline appearance in order to be acceptable. This test, which is based on the fact that a fibrous fracture is the result of adequate hardenability and suitable heat treatment, is a valuable inspection method, in particular where impact requirements are of importance.

Determination of Soundness

Whereas a few years ago the X-ray method was used only to a limited extent by casting manufacturers, the new trends in design, coupled with the increased application of castings for highly stressed parts, have emphasized more than ever the basic principle that the first essential of any metal structure is soundness.

Not only has the X-ray been found an invaluable tool in the development of the most satisfactory casting technique for new jobs, but it has also, mainly through the efforts of the ordnance department and air corps, become a standard method of inspection which, if used properly, will give added assurance as to the degree of soundness in any particular casting. Depending upon the importance of the part, the X-ray may be used for spot checking on a small percentage basis, or where the requirements make it necessary on a 100 per cent basis.

Approximately 50 per cent of the steel foundries in America are today using X-ray or radiography in one form or another to control their product. The radiographic standards for steel castings, as adopted by the ordnance department and how they operate, may be of interest. (Table 3).

Although these standards may have to be modified to suit the part in question they, nevertheless, afford a method of inspection which may be included in the specification, and thereby give the designing engineer and the potential user the guarantee, for lack of which he would not adopt a casting in the past.

The extent to which X-ray equipment has been developed for foundry work is indicated in a 1,000,000 volt X-ray machine in operation in the Ford Motor Co. steel foundry. (Fig. 1).

Magnetic methods, such as the magnaflux and the lately developed magnaglow or fluorescent method, for the detection of minor cracks and surface imperfections are continuously finding wider applications as an inspection method for highly stressed castings.

Design Factors

Frequently designs are submitted to the foundry which do not lend themselves to the manufacture of a satisfactory casting. Many times a relatively small correction, which

Table 3

RADIOGRAPHIC STANDARDS FOR STEEL CASTING, INCLUDING CAST ARMOR

Type of Defect	ORDNANCE DEPARTMENT STANDARDS				
	Standard 1.	Standard 2.	Standard 3.	Standard 4.	Standard 5.
Gas Cavities and Inclusions	A	A	A	A	A
	B	A	A	A	A
	U	B	A	A	A
	U	U	U	B	A
	U	U	U	U	B
	U	U	U	U	U
Pipe and Center—Line Shrinkage	B	A	A	A	A
	U	B	A	A	A
	U	U	B	A	A
	U	U	U	B	A
	U	U	U	U	B
Cracks and Tears	Cracks or tears are cause for rejection when the length is equal to or greater than T/2, or when the sum of the lengths of discontinuous cracks or tears is equal to or greater than T/2 in a length of metal equal to 6T, where T is equal to the thickness of the metal.				

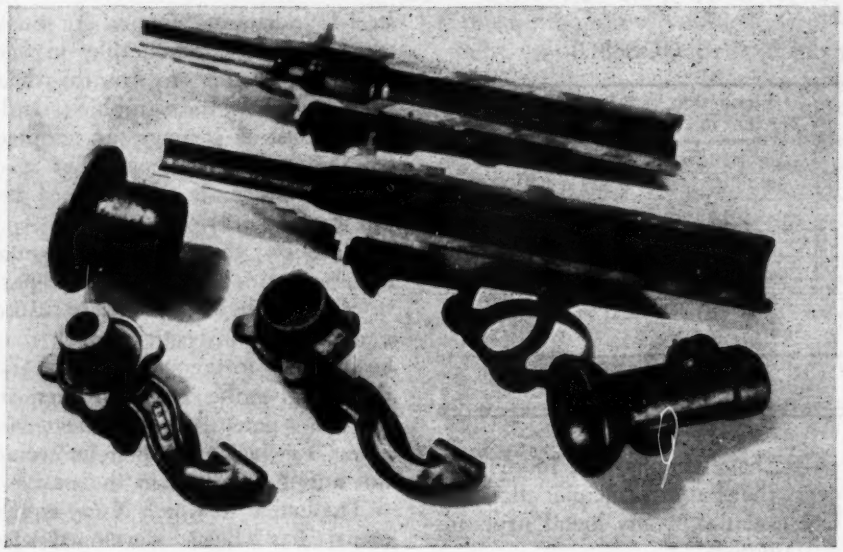


Fig. 5—Cast versus fabricated truck rear axle housing tube.

will not alter the shape of the part sufficiently to be prohibitive, may change a casting from a bad job to a good one.

Much would be gained if at all times the designing engineer would keep in mind that the ideal design is one where all members of the part increase progressively in thickness to one central location, where a riser or feeder can be placed which will supply the metal required to offset shrinkage. We fully realize that this is not always possible, but it should form the basic thought behind any casting design.

Frequently it has been found advantageous to cast the part in sections which later can be joined together rather than to attempt casting in one piece. The importance of close cooperation between the engineer, foundryman, and metallurgist not only in the design of the casting but also in the selection of the material cannot be over emphasized. Much time can be saved and many headaches eliminated thereby.

A case illustrating this point is shown in Fig. 2. The original design of this simple but highly stressed tank casting (a) did not lend itself to the manufacture of a 100 per cent sound casting, with the result that several failures occurred. A slight alteration based on the principle discussed above eliminated the difficulties (b).

Castings Versus Fabricated Assemblies

Simplification in design and manufacture is the major advantage of a casting. Many fabricated structures necessitating the making of a larger number of parts, which later have to be assembled through welding or by other means, can be changed to a casting thereby saving time, money and valuable equipment. This is particularly of importance today when our war-time needs require that every piece of equipment is utilized to its fullest extent, but future designs will also be affected through this trend.

We have selected 3 different castings which, we believe, are rather typical of this substitution of castings for fabricated parts. Figure 3 shows a fan shroud for a medium tank, which normally would be manufactured by fabricating but which by casting resulted in considerable simplification of manufacture and reduction in cost.

Figure 4 shows a 75 mm. gun recoil. The cylinder originally was designed as a fabricated job composed of approximately 18 pieces which had to be welded together. By adopting a cast design the part is now made in 4 pieces, assembled through butt welding.

The manufacture of the Ford truck rear axle housing tube, shown in Fig. 5, was greatly simplified by changing to a casting.

Component Members in Welded Assemblies

The metallurgical improvements of the last few years, coupled with the foundries ability to manufacture sounder castings, has resulted in the increased utilization of castings as integral parts of composite welded structures. Although not entirely new, this is a departure which allows for a much greater field of application and, consequently, greater freedom in design.

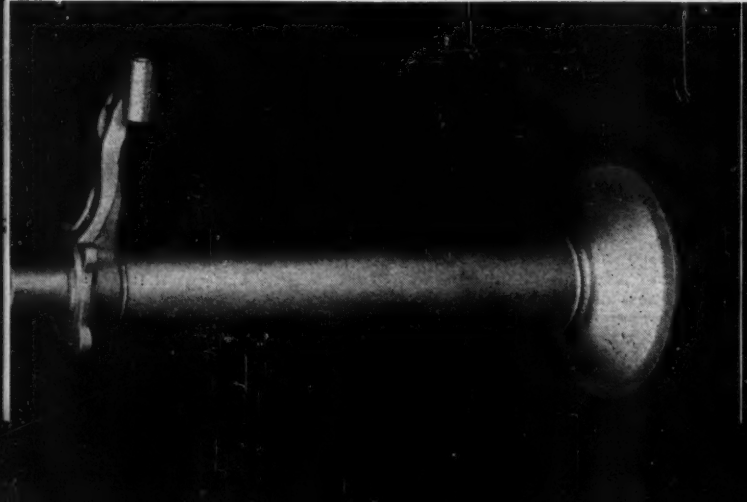
A contributing factor has been the extensive research conducted on welding of cast steels, which has now eliminated many of the difficulties encountered in the past.

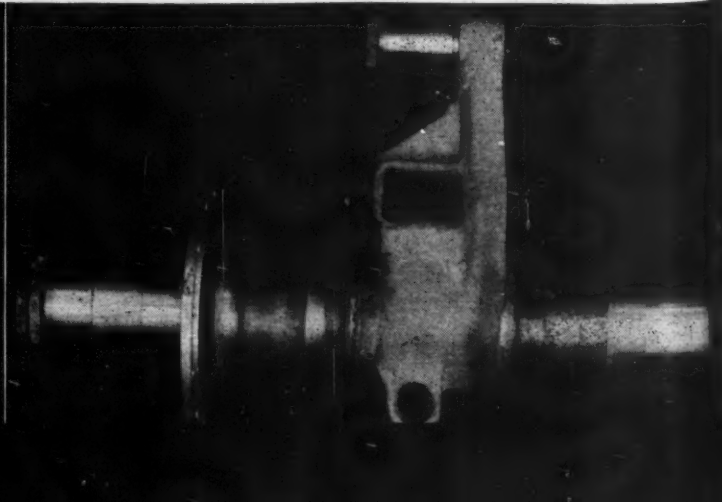
The use of castings as component members of welded assemblies is illustrated in Figs. 6 and 7, showing a rear axle housing for a Ford passenger car, and a housing for a 9-ton armored car.

In addition to demonstrating the

Fig. 6—Fabricated rear axle housing incorporating cast hub and spring perch.

Fig. 7—Rear axle housing tube for 9-ton armored car composed of a steel tubing, static casting and centrifugal casting.





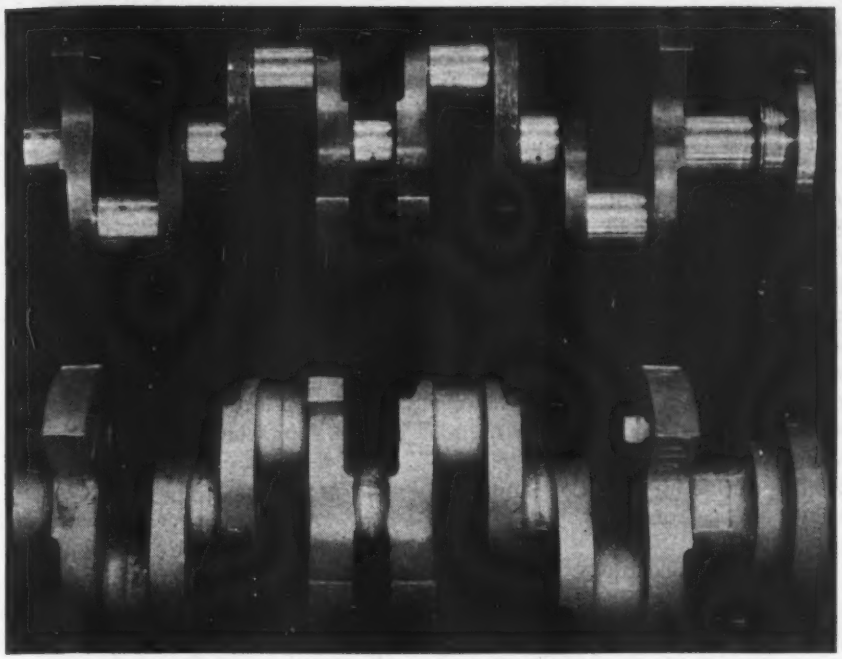


Fig. 8—600 horsepower tank engine cast steel crankshaft.

utilization of a casting in this assembly, Fig. 6 shows an interesting illustration of selective hardening applied to a casting. Prior to welding in the assembly, this casting is fully hardened to meet the necessary requirements. It is then induction hardened at the hub end to a minimum of 58 Rockwell, necessitated by the utilization of this hub as part of the roller bearing. The casting used in Fig. 7 is also hardened locally in the square hole to resist the wear of springs seated in this bracket.

Substitute for Forgings

The critical shortage of forging equipment has necessitated the manufacture of certain parts by casting, which previous standard practice had decreed to be forgings. It is of interest to note that many of these parts have proved very successful, and the experience gained will be a valuable aid in guiding the selection of manufacturing methods for future designs.

A 600-horsepower tank engine cast steel crankshaft (Fig. 8) is an interesting illustration of the extent to which steel castings have been applied as a result of the emergency. This has been made possible, not only through careful selection of material and design but also through rigid control of manufacturing procedures and utilization of X-ray and magnaflux for the elimination of defective castings. It may be of interest to point out that this crankshaft is surface hardened through nitriding after machining.

To further illustrate the substitution of castings for forgings, we have selected a landing gear shock strut, used on one of our best known carrier fighter planes. This casting (Fig. 9) heat treated to meet a minimum of 150,000 psi. minimum tensile strength, has proved very satisfactory.

High Temperature Work

The vastly increased requirements of the aircraft industry for materials and parts suitable for operation at high temperatures has led to very interesting casting developments. These particular designs often are such that fabricating methods become prohibitive or even impossible, and the service requirements are such that alloys frequently have to be used which do not readily lend themselves to such methods of manufacture.

With few limitations of shape or design present in castings, and most of the alloys required readily cast, developments of this type will undoubtedly form the basis for methods which will influence future engineering developments, in particular in connection with jet propulsion.

In the manufacture of superchargers a number of castings recently have been introduced which have greatly simplified manufacturing problems, thereby saving much time and labor. Figures 10, 11 and 12 show a fabricated nozzle box diaphragm, a close up of the same, and a cast diaphragm, respectively. The tremendous amount of labor required in fabricating this part is evidenced in Fig. 11.

Improvements in Malleable and Cast Iron

Malleable Iron

The recent developments in the malleable industry have been directed toward improvements in metallurgical control and the effect of various additions, in particular boron as a graphitizer, as well as studies relating to the effect of occluded gases upon graphitization. The malleable industry has, in addition, undergone a great expansion and modernization, particularly in its heat treating equipment which has placed it in a position to meet the challenge of the steel and nonferrous casting industries.

The malleable industry has played a particularly important role in the recently accelerated truck program, through the development of malleable rear axle housings of considerably larger size than thought possible with this type of material in the past.

A particular type of malleable, called "pearlitic malleable," has found widespread application as a substitute for small plain carbon steel forgings not requiring welding.

Cast Iron

Cast iron had some difficulty in finding its place in the war picture.

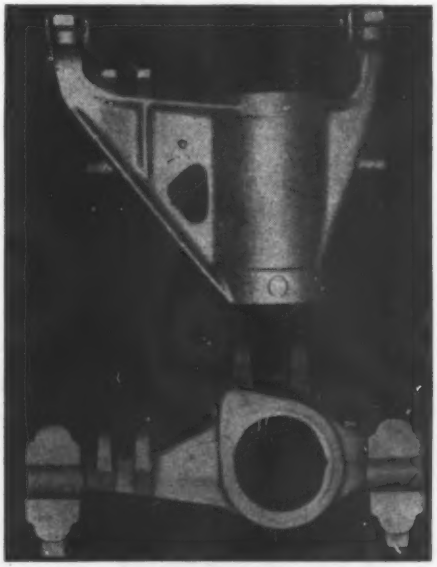


Fig. 9—Landing gear shock strut steel casting for fighter plane.

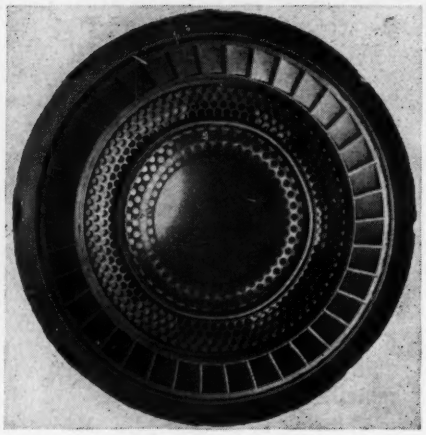


Fig. 10—Fabricated nozzle box diaphragm for supercharger.

Recent developments based on the inoculation methods, coupled with an increased knowledge of the effect of pouring temperatures, rate of cooling, etc., on structure and properties, has resulted in irons greatly superior to those of a few years ago. Physical properties ranging as high as 60,000 to 80,000 psi. tensile strength, while the castings still retain machinability and a certain degree of toughness, are not unusual today.

As a result, many highly stressed parts are now manufactured in cast iron, an outstanding example of which are crankshafts for large diesel engines.

Future Trend

In predicting the future trend, we believe that the following basic factor will receive considerable attention.

All steels originally are cast; the difference, therefore, between a casting and a forging is largely due to the effect mechanical working has in breaking up the cast structure, increasing the density of the material, and minimizing the effect of non-metallic inclusions.

In order to arrive at equal properties, regardless of method of manufacture, it will, consequently, be necessary to introduce external or other forces, which through their effect, will reduce grain size, minimize the tendency towards shrinkage cavities and, in general, increase the density thereby simulating the effect of mechanical working. Some such methods already have found widespread application, others are in the development stage, and still others are yet unborn.

Conclusions

We have made an attempt to present what we believe to be the most important developments and improvements relative to static ferrous castings. In particular, we have sought to analyze the influence that these developments may have upon future design and manufacturing methods applicable to automotive, aircraft and similar products.

We have emphasized the fact that the improvements are at least partly the result of war-time necessities, forcing the designers to adopt castings for highly stressed parts. We have also shown that these greatly increased requirements have brought about extensive research and new developments, which have led to the introduction of new steels and molding materials, as well as improvements in melting, molding, and heat treating techniques, along with better methods of inspection and greater uniformity of the product.

The progress made is indeed encouraging and, we believe, the designer will be able to take much greater advantage of the casting as an engineering material than he has in the past.

Our optimism, however, is tempered somewhat by the knowledge that many unsatisfactory castings, full of shrinks, pin holes, cracks, dirt, and what have you, are still finding their way to the consumer. The responsibility for this condition, we believe, rests with a relatively small number of foundries, but the effect is felt by the whole industry.

We can only suggest that a way of minimizing this condition is for the engineer and the user first to satisfy themselves that the design is sound, and then to issue specifications which definitely clarify the requirements of the particular part, both as to mechanical properties and soundness.

With different grades of castings made in most foundries, some such method is necessary in order that the foundryman may direct the proper attention to the part in question and introduce methods of process con-

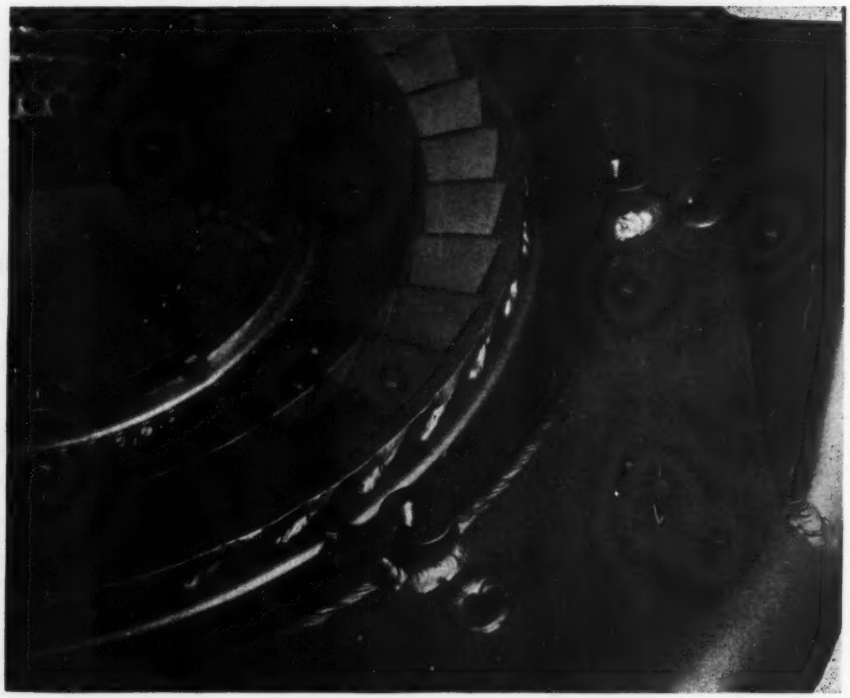


Fig. 11—Close up of fabricated nozzle box diaphragm.

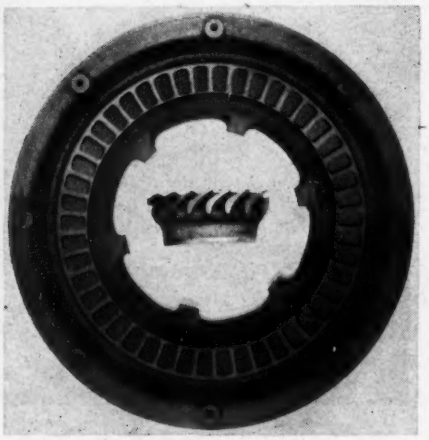


Fig. 12—Cast nozzle box diaphragm.

trol which will result in a uniformly satisfactory product. The added assurance of higher quality castings obtained will justify the slight increase in cost that may result.

Acknowledgment

The author wishes to express his appreciation to the Ford Motor Co. for permission to use its equipment and facilities in the preparation of this paper and, in particular, to R. H. McCarroll for his support and many valuable suggestions.

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SO. CALIFORNIA LECTURE COURSE
On Properties of Cast Metals

ROBERT GREGG, chairman of the Southern California Chapter's Educational and Apprentice Training Committee, which is working with the University of California's War Training Program to make the forthcoming lecture course on "Design and Engineering Properties of Cast Iron" an outstanding success, has the honor of having been the group's first Chapter Chairman.

Mr. Gregg and his coworkers have laid a sound foundation for the course which will hold seven sessions at the Huntington Park High School. Nothing has been overlooked, even to extra gasoline allowances for those attending the series of lectures. Anyone interested in securing additional gasoline is instructed to make application at the first class meeting, although the allowances will come through local ration boards. It is expected that the average attendance will be between 250 and 300.

Robert Gregg, Reliance Regulator Corp., Alhambra, Calif., is chairman of the committee which has arranged the course.

J. A. Burgard, Columbia Steel Co., will serve as instructor for the course which will cover the basic theory of foundry technique, with special emphasis placed on linking theory to practice.

The nominal registration fee of $5.00 to A.F.A. members and $7.00 for non-members covers the tuition-free course, including the seven lectures. The complete first draft of the interesting program appears elsewhere on this page, and the chapter is mailing 2,500 individual copies to users of castings and foundrymen in the area.

Southern California Lecture Course Schedule

Jan. 22, 1945—*Design of Castings*

John E. Wilson, Climax Molybdenum Co. of Michigan - - - - - - - - - - - - - Lecturer
C. J. Bradley, Dayton Foundry - - - - - Chairman

Jan. 29, 1945—*Casting Processes*

Wm. D. Emmett, Los Angeles Steel Casting Co. - - - - - - - - - - - - - - - - Static Casting
A. E. Falk, Centrifugal Casting Co. - Centrifugal Castings
Max Powell, Harvill Die Casting - - - Die Casting
Milton Hagener, American Chain Link Machine Co. - - - - - - - - - - - - - - - - Chairman

Feb. 5, 1945—*Selection of Cast Alloy*

Edward G. Fess, Metallurgist - - - - - - Lecturer
P. D. McElfish, Kilsby & Graham - - - - Chairman

Feb. 12, 1945—*Cast Steel and Its Heat Treatment*

(Including plain carbon and alloy cast steel.)
John E. Wilson, Climax Molybdenum Co. of Michigan - - - - - - - - - - - - - Lecturer
E. C. Hummel, Utility Electric Steel Foundry - Chairman

Feb. 19, 1945—*Cast Iron and Its Heat Treatment*

(Including alloyed and unalloyed white, gray and malleable cast iron.)
Albert G. Zima, International Nickel Co. - - Lecturer
E. F. Green, Axelson Mfg. Co. - - - - - Chairman

Feb. 26, 1945—*Cast Aluminum, Copper and Magnesium Alloys and Their Heat Treatment*

Roy E. Payne, Aluminum Co. of America - - Lecturer
Robert R. Haley, Advance Aluminum & Brass Co. - - - - - - - - - - - - - - - - Chairman

Mar. 5, 1945—*Inspection of Castings*

Charles W. Phillips, Utility Electric Steel Foundry - - - - - - - - - - - - - - - - - - Lecturer
Leslie W. Ball, Triplett and Barton, Inc. - - - Chairman

THE A.F.A. STORK VISITS CENTRAL OHIO

Board of Directors Approves 28th Chapter for Association

FOUNDRYMEN of the Central Ohio area received a Christmas present of their own fashioning on December 20, when the Central Ohio Chapter of A.F.A. was officially constituted in appropriate ceremonies held at the Fort Hayes Hotel, in Columbus. With announcement that the National Board of Directors had unanimously approved the group's petition for chapter status, the 28th A.F.A. Chapter was declared formed, the fourth in the State of Ohio.

H. Kenneth McGrath, Alten's Foundry & Machine Co., Lancaster, presided at the inauguration meeting as General Chairman of the local Organization Committee. One of the prime movers in formation of the new group, Mr. McGrath introduced W. W. Maloney, Business Manager of A.F.A., who, acting on behalf of Secretary R. E. Kennedy, declared the new chapter operative.

National Director I. R. Wagner, Electric Steel Castings Co., Indianapolis, Ind., described briefly some of the broad activities of the Association and urged members to play an active part in A.F.A. affairs. "A man gains," he said, "as he gives something of himself toward advancing his own profession."

Passing on the Rattle

Hugh Robertson, American Steel Foundries Co., Alliance, and Vice-Chairman of the Canton Chapter, was called upon to present the traditional symbol awarded each new "baby" chapter. Mr. Robertson relinquished the cast iron baby rattle to Chairman McGrath with the prediction that he might soon have the honor of passing it on, in turn, to another new member of the A.F.A. family.

H. Kenneth McGrath
Chapter Chairman

Thomas Barlow
Chapter Vice-Chairman

N. J. Dunbeck, Eastern Clay Products, Inc., Eifort, Ohio, as Chairman of the Membership Committee, announced that the new "baby" was beginning life with over 100 Charter members. He urged plant executives to bring some of their promising men to future meetings so that they may see for themselves the advantage in becoming members.

Continue to Serve

Announcement was made that all officers and members of the organization committee responsible for the chapter would continue to serve until the end of the fiscal year, when regular elections of chapter officers and directors will be held. The organizational committee, to whom all credit must go for creation of the Central Ohio group, consists of the following:

General Chairman, H. K. McGrath, Alten's Foundry & Machine Works, Lancaster.

Co-Chairman, T. E. Barlow, Battelle Memorial Institute, Columbus.

Secretary, Frank Kiper, Ohio Steel Foundry Co., Springfield.

Treasurer, Fred Fuller, National Engineering Co., Columbus.

N. J. Dunbeck, Eastern Clay Products, Inc., Eifort.

David Whyte, Cooper Bessemer Corp., Mt. Vernon.

Allen Cleaver, Newark Stove Co., Newark.

F. W. Hoffman, Hoffman Cabinet Works, Lancaster.

Jack Schram, Swan-Finch Oil Corp., Columbus.

R. H. Frank, Bonney-Floyd Co., Columbus.

C. E. Bales, Ironton Fire Brick Co., Ironton.

J. G. Garrard, Ohio Malleable Iron Co., Columbus.

W. R. Huffman, H. B. Salter Mfg. Co., Marysville.

Karl G. Presser, National Supply Co., Springfield.

J. J. Witenhafer, Columbus Malleable Iron Co., Columbus.

C. F. LaMarche, American Malleable Castings Co., Marion.

John F. Lacey, Commercial Steel Castings Co., Marion.

K. W. Whitlatch, Aetna Fire Brick Co., Oak Hill.

Discuss Foundry Problems

Following the formation ceremonies, the meeting was given over

Organization Committee for Central Ohio, 28th A.F.A. Chapter.

to technical discussion of "Fundamental Foundry Problems." R. G. McElwee, Vanadium Corp. of America, Detroit, and Chairman of the Detroit Chapter, was the guest speaker. While much of this talk concerned gray iron shop problems, he pointed out how the solution of many iron problems apply equally in steel and other shops. His talk proved an excellent beginning for the chapter's technical program.

Before adjournment of the meeting, it was announced that a program of monthly meetings has been prepared, to be held at the Fort Hayes Hotel in Columbus until further notice, usually on the third Tuesday of each month. Co-Chairman Tom Barlow is acting as chairman of the Program Committee. J. J. Witenhafer heads the Committee which will draw up a set of by-laws for presentation to the chapter at a future date.

The petition for a Central Ohio Chapter of A.F.A. was drawn up and signed at a meeting held November 20 at the Fort Hayes Hotel. H. Kenneth McGrath presided, and National Secretary R. E. Kennedy described the many advantages, for both individuals and their firms, to be gained through membership.

A feature of the meeting was an illustrated talk by Harry W. Dietert, Harry W. Dietert Co., Detroit, on the effect of mold atmosphere on castings surfaces. With slides and motion pictures, Mr. Dietert described the effects of oxidizing and reducing atmospheres and told of experiments in the control of mold atmospheres by means of facing materials and various molding sand agents.

Inspection Committee Plans Congress Sessions

THE Inspection of Castings Committee held its second committee meeting of the season at the American Foundrymen's Association office, December 6, Chicago, with Chairman Harold W. Warner, Allis-Chalmers Mfg. Co., Milwaukee, presiding. Other committee members present were: Secretary E. F. Platt, Sperry Gyroscope Co., Inc., New York; Gustav Dewald, Ampco Metals, Inc., Milwaukee; E. G. Leverenz, American Steel Foundries, Indiana Harbor Wks., East Chicago, Ind.; F. Poettgen, American Steel Foundries, Cast Armor Plant, East Chicago, Ind., and H. C. Stone, Belle City Malleable Iron Co., Racine, Wis. Past Chairman M. D. Johnson, Caterpillar Tractor Co., Peoria, Ill., who was unable to attend the meeting, sent his comments for consideration by the committee.

A large portion of the meeting was devoted to the sessions to be allocated to the inspection of castings at the A.F.A. Congress, to be held in Detroit, April 30-May 4. It can now be reported that definite progress has been made in securing papers and topics of vital concern to top management as well as to the rank and file of foundrymen.

AMONG the most recent awards for high achievement in war production in the foundry field was the Army-Navy "E," presented to the City Pattern Foundry and Machine Co., Detroit. Vaughan Reid is president of the company.

Grading and Fineness Committee Names Chairman

ROBERT E. MOREY, Naval Research Laboratory, Anacostia Station, Washington, D. C., has been appointed Chairman of the Committee on Grading and Fineness, Foundry Sand Research Project.

Mr. Morey brings to the Committee, as chairman, a wide experience in foundry-sands and, particularly, in the problems of grading and fineness. For the past several years, he has devoted much of his time to a study of this problem, and your Association feels that under Mr. Morey's direction, great progress will be made in stabilizing the problems of classifying foundry sands.

Castings Defects Group Prepares for Congress

PLANS are under way for the Committee on Analysis of Defects to take over two sessions of the Gray Iron Shop Course series of the A.F.A. Congress in Detroit, April 30-May 4. Slides are being prepared from illustrations in the committee files for use during these sessions in order to make them as interesting and informative as possible.

The committee has been meeting monthly in the A.F.A. offices in Chicago since July, 1944, and has held regular meetings since it was organized in 1940.

The following committee members have been in regular attendance for the past six months: *Chairman,* W. A. Hambley, Allis Chalmers Mfg. Co., Milwaukee; *Vice-Chairman,* E. J. Carmody, C. C. Kawin Co., Chicago; *Secretary,* A. S. Klopf, Firegan Sales Co., Chicago; George Anselman, Goebig Mineral Supply Co., Chicago; T. E. Barlow, Battelle Memorial Institute Columbus, Ohio; W. B. McFerrin, Electro Metallurgical Co., Detroit; C. V. Nass, Pettibone Mulliken Corp., Chicago; and C. Zahn, Vilter Mfg. Co., Milwaukee.

Much information concerning castings defects has been gathered, compiled and revised and the committee expects to publish a progress report in the near future.

GRAY IRON . . .

Its Economy, Adaptability and Versatility

Viewed as an Engineering Material

• This paper, originally presented at a Gray Iron Session of the 48th Annual Meeting of the American Foundrymen's Association, Buffalo, April, 1944, points out that cooperation between the designing engineer and the foundryman can greatly influence the future use of cast iron as an engineering material.

By
R. G. McELWEE
Vanadium Corp. of America
Detroit

IN APPROACHING a subject of this kind, it becomes necessary to define quite clearly the material which is the subject of the discussion. This is particularly necessary at this time because of the confusion caused by enthusiastic producers of proprietary materials, who have assigned to those materials trade names indicating that they are something other than the authoritative definition covers.

It is probably safe to say that the A.S.M.E., which is a scientific body, concurs with the opinions and the recommendations of other recognized scientific bodies which have common problems. By common consent, all metallurgists have agreed on the classification of ferrous castings into three groups: steel, malleable and cast iron.

Accepted Definition

The Government agencies recognize this grouping, which is entirely practical. Any sub-divisions are also clearly recognized, such as pearlitic malleable and fully annealed malleable. Therefore, in order to clarify the discussion, the following definition, taken from the latest handbook of the A.S.T.M., is offered. This will be found on page 1090 of the 1942 volume, contained in specification number A196-42T:

"Cast iron is essentially an alloy of iron, carbon and silicon, in which the carbon is present in excess of the amount which can be retained in solid solution in austenite at the eutectic temperature. When cast iron contains a specially added element, or elements, in amounts sufficient to produce a measurable modification of the physical properties of the section under consideration, it is called alloy cast iron. Silicon, manganese, sulphur and phosphorus, as normally obtained from raw materials, are not considered as alloy additions."

With this definition in mind, any material which is offered can be examined and determined whether or not it is cast iron.

Recent Developments

In view of the remarkable developments which have taken place in the ferrous industry during the past decade, it is particularly fitting that we should discuss the application of these ferrous materials from an engineering standpoint. Steel, malleable and cast iron in most cases are not interchangeable.

Each type of casting possesses physical properties which make it ideal for certain types of work, and it is the desire of the American Foundrymen's Association, to clarify, if possible, the relative merits of cast iron as against other ferrous castings for those applications for which it is best suited.

To accomplish this purpose and to enable the designing engineer to take advantage of the properties offered, it may become necessary for him to revise his specifications so as to describe accurately the property about which he is concerned. It might be well at this point to discuss some of the commonly known properties and those which are most frequently found in specifications.

Tensile Strength

While there have been tremendous advances in the production and metallurgy of cast iron and it is generally possible to obtain castings with minimum tensile strength as high as 60,000 psi., and in a few castings as high as 80,000 psi., it is my personal opinion that the tensile specification has been considerably overworked.

An examination of applications certainly will indicate that a relatively small percentage are actually loaded in tension, and it becomes apparent that a tensile specification is written with the subconscious thought that, by so doing, some other property is described which may be desirable for the part involved.

The danger in this approach is that other properties may be incompatible with tensile strength. This would be particularly true of damping capacity and possibly true of resistance to heat shock and resistance to wear. It has been my experience that tensile strength has been specified in many cases where some sort of structure control, or structure specification, would have seemed much better because it is more closely related to wear.

There exists a general relationship between composition and strength and the graph (Fig. 1) shows this for irons of varying degrees of carbon saturation expressed as carbon equivalent. The slope of the curve indicates a change of approximately 2000 psi., for each 0.1 change in carbon equivalent. The use of alloys and special inoculation treatment tends to elevate the curves without materially changing their slope.

It should be remembered that shrinkage troubles increase as carbon is lowered, and that a combination of reasonably high total carbon and treatment usually results in a

sounder casting than a combination of carbon-silicon in which strength is secured solely by the reduction of carbon. It is sound castings we want rather than ideal test bars.

Hardness

What has already been said about tensile strength also applies to hardness. It has been amply demonstrated by research workers that hardness is not a true index or function of wear resistance. Hardness is not necessarily related to toughness, and toughness may be as important for certain types of wear as hardness. Undoubtedly a combination of the two properties should be a part of the specification.

The measurement of hardness in gray cast iron is almost universally determined by means of a 3000-kg. load on a hardened steel ball 10 mm. in diameter. It is believed that this method is most reliable on a heterogeneous material such as cast iron. Any method using a smaller penetrater is open to the objection that the point may be placed in a particle of graphite and, as a result, the reading will be too low.

Unlike steel, the hardness in cast iron has but a remote relationship to tensile strength. Experience has demonstrated that in practically no type of wear is there a direct factor of relationship to hardness. It is felt that the heterogeneity which makes hardness measurements difficult is beneficial with respect to most types of wear.

As a specification, hardness is usually shown with at least a subconscious thought of offering a control of microstructure. It is recommended that microstructure specifications be used instead, as being more reliable for general use.

Transverse Strength

This property, which is frequently used as a routine control in the foundry, can be a dangerous specification for the engineer. Cast iron is peculiarly susceptible to the effect of cooling rate, and a test bar may be made from an iron which is highly susceptible may have a very dense exterior and a very open core and may, as a result, show remarkable transverse properties. Obviously the tensile bar machined from this same iron would have relatively low values because that part of the bar which is of the greatest value has been lost in machining, and that section of the bar in which the break occurs may be from a very weak iron.

Bear in mind, that many castings are machined and that the face of the casting is lost and transverse tests will not indicate the true strength of the material under the skin. It should be added that foundrymen have been particularly concerned with the reduction of sensitivity to cooling rate and that much has been accomplished in this direction. While it is obviously very difficult to establish a specification or test procedure which will cover transverse tests applying to any casting with a wide variation of section, it is possible to set up a wedge determination which will be most helpful in showing the adaptability of any iron for the sections involved.

Figure 2 shows the wedge and the standardization to casting must be a matter of experimental procedure. Limits are imposed which designate maximum chill at the tip with a B.H.N. limitation at a certain distance from the tip as established by examination of the heaviest section of the casting and a hardness exploration of the wedge to find a similar value. Once established this gives reasonable assurance of structure control in the casting which tends to reduce undue sensitivity to section.

Deflection

Since it is difficult to measure elongation of a tensile test bar in cast iron because of the extremely low value, it has become common practice to use the deflection of a bar broken transversely. The remarks made about transverse strength apply to this property as well, but we should add to the discussion the fact that a great many transverse tests are subject to error due to deformation of the bar at the point of loading and the establishment of the zero point and other factors which may make the total error as high as 15 or 20 per cent of the value read.

What has been said indicates clearly that deflection readings increase in value with the length of the specimen. Stress-strain curves of transverse tests are valuable when experience enables them to be evaluated. At least a rough measure of percentage plastic and elastic deformation can be determined from the shape of this curve.

Modulus of Rupture

This is the property which has been somewhat arbitrarily adopted by the cast iron industry as a means of describing the extreme fiber stress that would be used in a beam formula. It usually has a value from one-and-a-half to two times the tensile strength. The higher value is accounted for by the previously described tendency for iron to be denser on the surface but also by the fact that iron is less susceptible to notch effect in bending than in tension.

This property is little used as a specification; the fact that it bears

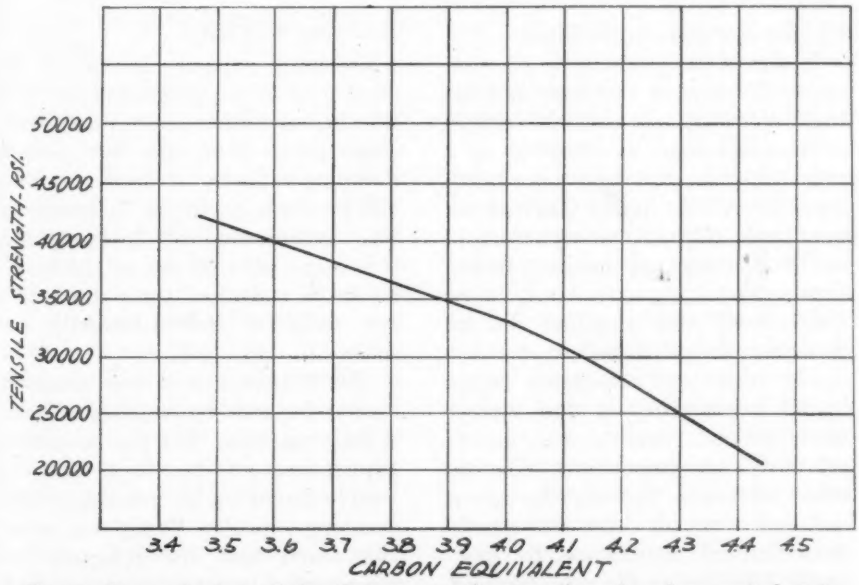


Fig. 1—Curve showing relation between tensile strength and carbon equivalent in cast iron.

no definite relationship to tensile strength or modulus of elasticity precludes such use. It is an indication of the ratio of surface structure to core structure, and it is of value as an indication of properties at and just beneath the surface.

Compressive Strength

In some applications this may be of great value. It usually falls within three to five times the tensile strength, but for certain unusual applications it should be tested for the iron involved. Many applications of cast iron involve compression loading to the exclusion of any other type, and the relatively high values which can be used for cast iron loaded in this manner make it an ideal material.

Modulus of Elasticity

All sorts of values have been claimed for the results of various processes in the manufacture of cast iron. However, the usual range is from 12,000,000 to 20,000,000, and in some cases to 26,000,000 psi. Again it is not a direct function of tensile strength, although the trend is for higher strength irons to show the higher modulus.

It is not necessarily true that a higher modulus of elasticity indicates a better iron for all applications. In the case of an automotive brake drum, which is subjected to very severe loads and sustained for a sufficient period to cause the inner surface to attain a high temperature, the lower modulus iron would seem to be indicated.

Experiments have shown the truth of this statement. As the inner surface of the drum tends to expand, it is confined by the cooler outer surface and if the outer surface is sufficiently rigid the inner surface fails in compression. Heat checks are much less prevalent in high carbon irons with their lower modulus of elasticity.

In cases where rigidity is important a high modulus iron would be indicated. It should be remembered, however, that this property is incompatible with damping capacity, for the nearer the approach to the modulus of steel the lower will be the ability to absorb vibration. It has been found that, generally speaking, a high modulus accompanies low graphite content and vice versa. For some applications involving wear resistance, the reasonable graphite content may be more important than the higher modulus.

Plasticity

There is not sufficient time to deal with this subject adequately. However, the relative value of plasticity and elasticity can be measured quite readily by making a stress-strain curve in transverse loading. In certain types of work plasticity may be important; within limits it can be controlled. Because cast iron is not sensitive to notch effect, it is possible to produce an iron which will take considerable permanent set in a transverse test that is stopped just short of rupture and still have no visible evidence of local failure. This property, which is related to elongation in materials without flake graphite, may be valuable as an indication of the ability of the material to absorb relatively high local stresses without failure. A specific example is the brake drum described under "Modulus of Elasticity."

Shear Strength

Shear tests have not been widely used, but there is considerable data available and the values can be assumed to range between 1-4/10 and 1-8/10 times the tensile strength of the iron. Bolton points out in his book that the test for shear strength is subject to considerable error unless every effort is made to eliminate transverse bending. Since the test is subject to at least as much error as the transverse test there seems to be no reason for its use as a routine test.

Fatigue and Endurance Limit

It should be particularly interesting to the user of cast iron that the ratio of fatigue to tensile strength is relatively high as recorded in a series of tests which have been taken from the A.F.A. ALLOY CAST IRONS handbook. The values were from 43 to 58 per cent of tensile. Bolton covers this subject in his book, *"Gray Cast Iron,"* and amplifies the information found elsewhere.

The important conclusion drawn by all investigators is that surface imperfections, notches, etc., are of relatively less importance than in other materials. Specifically, one of the first tests of iron crankshafts demonstrated endurance by purposely misaligning the main bearing. The investigators were amazed at the relatively high number of cycles to failure, as compared to forgings, etc.

Impact

Because of the nature of cast iron, it being a heterogeneous material, the customary impact specimen for steel has little value. Instead, it has been recommended that a Charpy specimen be made 1-1/10-in. in diameter and 8-in. long, and that this be broken on a Charpy machine with 6-in. between the supports.

Values will range from 20 ft.-lb. to 80 ft.-lb. with this type of specimen. It is important to note that impact strength does not follow tensile strength. In fact, a tough, weak iron may show a relatively high value against a brittle, strong iron. It is also significant that single blow impact tests, of the type just described, are not related to repeated blow impact tests in which the load is comparatively low, but applied many hundreds or thousands of times. The property of cast iron described under "Endurance Limit" probably influences the repeated blow impact introducing the endurance feature.

Another test which has found favor in certain industries uses a falling hammer in which the height of fall is increased by uniform increments until failure. In this test the specimen is prevented from rotating between blows, with the result that the plastic component is practically spent before the rupture occurs. The amount of set recorded just before rupture may be significant.

Damping Capacity

Damping capacity is one of the most important properties of cast iron because other ferrous materials, particularly steel, do not possess damping capacity to the degree that can be made useful, as in cast iron. For confirmation of this property, it is suggested that one of the handbooks be consulted since the values are more or less arbitrarily described.

The importance of this property cannot be over emphasized. There is little question that future critical applications of cast iron will be largely based on its relatively high damping capacity. Experience alone can teach how the designer can compromise between apparent high physical values in other stronger

materials and lower physicals in high damping capacity cast irons. One thing is certain, as designers realize their latitude in this direction more cast iron applications will be found.

Machinability

Relative values of machinability in cast iron and other materials are somewhat variable, and for exact comparisons investigation should be made of the work done at the University of Michigan by Prof. Boston and by other investigators. Generally speaking, cast iron is used for many parts because of the ease of machining.

There has been an erroneous thought in the minds of certain consumers that hardness is a direct index of this property. An analysis of many reports of difficulty of machining has been made, which has led to the conclusion that in a majority of cases hard or chilled edges should have been the complaint rather than the B.H.N. Brinell readings cannot be made on the edges and corners which usually present the greatest difficulty.

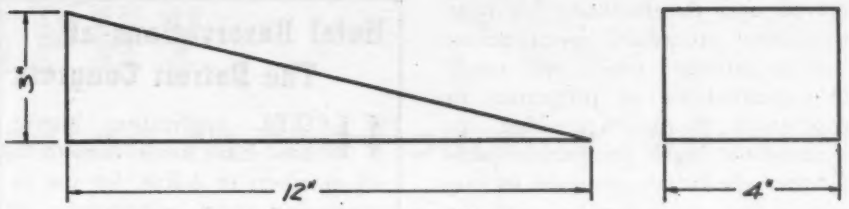
Uniformity of structure is also important if the best machining records are sought. That structure, composed of islands of primary ferrite surrounded by pearlite, often causes reports of apparent hardness probably because of the tendency of the tool to give what appears to be chatter as it travels from soft to hard spots and vice versa.

A microscopic examination of a section of the casting under consideration will be highly informative as to the desirable type of structure.

Wear Resistance

This is one of the properties which makes gray iron extremely useful. Because of the graphite particles, or inclusions, cast iron has the ability to retain an oil film far beyond the ability of any other ferrous material. It should be recalled that earlier mention was made of the fact that hardness does not bear direct relationship to wear resistance. This property of retaining an oil film does not appear related to the strength and the hardness but is related to the structure.

Wear resistant cast iron could best be specified by stating that the matrix shall be all pearlite, that is free from ferrite or cementite. This is particularly true where unit pressures are high as in cast iron worm wheels operating with steel worms. In such an application there is line contact with very high unit pressure.



WEDGE FOR STRUCTURE STUDY

Fig. 2—Wedge used to control properties of cast iron in accordance with the sections involved.

A study made some years ago indicated that either free ferrite or free cementite would tend to "pull out" and load the mating member, thus forming a cutting tool which formed grooves in the worm wheel. A perfectly balanced iron containing only pearlite and graphite showed much less tendency in this direction; hence the importance of structure control.

Heat Resistance

It has been known that cast iron has remarkable stability at moderately elevated temperatures and a study has recently been made, under auspices of the War Metallurgy Committee, the results of which indicate that the limitations which have been placed on the top temperatures have been too low for certain applications.

Recent investigations have also shown that cast iron has a remarkable resistance to heat shock for such parts as hot working dies, and that the iron for these applications should be specially chosen with a high degree of plasticity even though this involves relatively low strength and hardness.

It is necessary to differentiate between applications where temperature is maintained at or near a fixed value, in which case a different type of carbide stabilizer is indicated, than where temperatures change over a wide range. Where the temperature is sustained, chromium offers considerable resistance to breakdown; however, when the temperature is variable it is better to modify the base iron as indicated for plasticity. This means reasonably high carbon and the addition of sufficient amounts of proper alloys to contribute mechanical strength.

Design and Engineering Talent

These many properties have been mentioned and briefly described in the hope that the designing engineer will give more thought to the specification and the property which is of vital concern to him. The gray iron industry is vitally concerned in its desire to provide sufficient engineering talent in their contacts with you, the designers.

There are examples, however, where foundries have an engineering service which can discuss the properties they can provide and can assist in writing a specification so that these properties may be made useful. You, as designers, could do much to provide yourself with a useful material which is at the same time economical, by insisting that your foundry sources prepare themselves to help you write the specification, and to set up standards and methods of inspection which will maintain these standards.

It is not an accident that cast iron has been successful in crankshafts and camshafts and similar parts. However, these and any other applications require the closest cooperation between designer and foundryman. These last mentioned parts involve heat treatment and a volume could be written about the virtues of cast iron in this field.

For those of you who think along metallurgical lines your attention should be called to the fact that cast iron contains the carbon which you use for carburizing ,if you desire to harden the part. This makes the heat treatment cycle very simple and also makes cast iron susceptible to induction hardening, flame hardening and many other treatments which are normally thought of only in connection with steel.

Depending upon the section in-

volved and the facilities for heat treatment procedure specifications can be provided which will result in combinations of properties to cope with many engineering requirements. Such procedure specifications should be prepared by one who is thoroughly familiar with the effect of temperature on all sorts of structures and alloys. They will necessarily differ from specifications for steel because of the presence of a large amount of "free" carbon.

Cast iron is entitled, on a basis of its great versatility, to be used for many more parts than at present; however, the gray iron industry has a sincere desire to provide proper engineering talent for an intelligent discussion of new designs. Progress is being made in the utilization of that talent.

Evening Foundry Courses At Wis. U. in Milwaukee

MEMBERS of the Wisconsin Chapter are actively participating in the foundry subjects included in the courses in metallurgy being offered in the evening school programs at the University of Wisconsin in Milwaukee.

The courses now in progress are:

Beginning Metallurgy—Instructor, Guenther H. Hille, Ladish Drop Forge.

Electric Furnace Practices — Instructor, Edward D. Fahlberg, Grede Foundries, Inc., Milwaukee.

Physical Testing of Metals—Robert A. Burmeister, City of Milwaukee Testing Laboratory.

Principles of Heat Treatment—Robert C. Steveling, Ladish Drop Forge.

Sand Control—Wm. A. Hambley, Allis-Chalmers Mfg. Co.

Mr. Fahlberg takes his group to a different foundry each week, and the enthusiasm and interest has been so great that the class meetings frequently last until past midnight. Mr. Hambley adds to the interest and value of his classes by having guest lecturers address the group.

The following program will be included in the second semester:

Beginning Metallurgy—Instructor, Guenther H. Hille.

Welding Metallurgy — Instructor, Guenther H. Hille.

Gating and Risering and Casting Defects—Wm. A. Hambley.

Hotel Reservations at The Detroit Congress

HOTEL application blanks now have been mailed to all members of A.F.A. for use in requesting room reservations at Detroit for the 4th War Production Foundry Congress, April 30-May 4, 1945. Detroit hotels have guaranteed a sufficient number of rooms to take care of an attendance even larger than that at St. Louis in 1943, also a non-exhibit year.

Several factors presage a fine attendance at the Motor City Foundry Congress. An unusual number of excellent papers now are in preparation, and it is expected that several interesting plants will be open for inspection trips, some of them for the first time since Pearl Harbor.

Because of prevailing hotel conditions, it is anticipated that the number of single rooms available will be somewhat below the requirements of some previous years. Those planning to attend are therefore urged to *request double bed and twin bed rooms wherever possible.* In some instances it may prove necessary, as it has at several recent technical meetings, to make room assignments on the basis of double or twin accommodations.

1945 Housing Bureau

The assignment of hotel rooms for the Detroit meeting will be made only through the local A.F.A. Housing Bureau of long long experience, and all requests for rooms should be mailed direct to the Manager of A.F.A. Housing Bureau, 1005 Stroh Bldg., Detroit 26, Mich. It is especially important for all desiring hotel accommodations to note the following: **All room requests received on or before February 1, 1945, will be considered as of that date.**

As soon after February 1st as possible, definite room assignments will be made and applicants notified, as well as hotels to which they may be assigned. Every effort will be made toward a fair allocation of available rooms to both A.F.A. members and guests.

Study Microstructure of Brass and Bronze

CHAIRMAN B. A. MILLER, Brass and Bronze Division of A.F.A., Chief Metallurgist for the Cramp Brass & Iron Foundries Div., Baldwin Locomotive Works, Philadelphia, has announced the formation of a Brass and Bronze Division Committee on Microstructure of Brass and Bronze Alloys. The committee is composed of the following:

B. M. Loring, *Chairman,* Naval Research Laboratory, Washington, D. C.

G. P. Halliwell, H. Kramer & Co., Chicago.

G. J. LeBrasse, Federal Mogul Corp., Detroit.

Wm. L. Rudin, Universal Castings Corp., Chicago.

A. J. Smith, The Lunkenheimer Co., Cincinnati.

This committee will study the microstructure of brass and bronze, with the hope that it may be able to correlate microstructure with physical properties in copper-base alloys in a manner similar to the work that has been done on ferrous alloys. The committee eventually hopes to be able to bring out a publication on the microstructure of cast brass and bronze alloys and their interpretation.

A.F.A. Helps Advance Foundry Education

YOUR Association is represented officially in the Society for the Promotion of Engineering Education by Secretary R. E. Kennedy and Director, Technical Development Program, N. F. Hindle.

The function of the Society is to study and discuss the various factors relating to the proper education of embryo engineers. One of the committees of the S.P.E.E. is that on Relations with Industry, and Mr. Hindle has just been appointed a member of this committee.

It is interesting to note that the following individuals, conversant with the foundry industry, also are members of the committee: L. J. Fletcher, Caterpillar Tractor Co., Peoria, Ill.; Dean C. J. Freund, University of Detroit, Detroit; Dean C. E. MacQuigg, Ohio State University, Columbus.

RADIOGRAPHY

and Its Application to the Foundry Industry

• For the past three years, the Twin City Chapter has sponsored an annual Essay Contest for engineering students at the University of Minnesota. The two best papers on foundry subjects are awarded prizes, and the winning paper is presented at a regular meeting of the Chapter. Designed to influence engineering students to adopt foundry careers, the contest is a fine example of what chapters can do locally to interest young men in the foundry industry. The winning paper, by Cavour H. Hauser, is presented as an indication of the caliber of papers submitted in the competition, and not necessarily for its technical correctness.

ONE of the most important applications of radiography in industry is its use as a tool in developing a foundry production technique. Often in the foundry, defects otherwise not detectable are brought out clearly by radiography. Internal shrinkage cavities, flocculent shrink, blowholes from mold or metal gases, cracks, slag or sand inclusions and pronounced dendritic structure can be brought out by X-ray technique.

The only way in which these defects could be detected otherwise would involve expensive destructive testing, such as sectioning. Even sectioning is inadequate in finding many defects, either because of their small volume, or because the casting involved would be impossible to section.

Eliminating Defects

In foundry practice, the development of a production technique often involves the elimination of defects which occur repeatedly in the same location of a given casting. The general procedure is as follows:

1. Make a trial casting using the best possible technique, judging from past experience, good general foundry practice, and consideration of the problems involved.
2. Thoroughly radiograph the trial casting, noting any defects which would impair its usefulness.
3. Make a second casting, modifying foundry technique, trying to eliminate defects found on the first trial casting.
4. X-ray the second casting, etc.

The process is repeated continually until a casting proved satisfactory by X-ray examination is produced. It is a method of trial and error, but so far no better method has been developed. Of course, improvements in the casting procedure should be made on the basis of careful research and experience, so that the minimum number of trial castings need be made. It is evident that the X-ray method of testing the castings is far superior to that of sectioning, especially in the case where many tests become necessary.

In some cases, the casting procedure may involve castings so large that the expense of producing large numbers of them would be prohibitive. In this case, a smaller scale pilot casting may be used and the casting technique can be developed from this relatively inexpensive casting. In addition, the pilot casting, being smaller, will require fewer X-rays to be taken.

In making the pilot casting, it will be necessary to modify the proportional dimensions so that the solidification lines in the pilot will be the same as those of the original casting. In determining the final casting technique, it should be the aim of the foundryman not only to produce a sound casting, but to reduce the metal in gates and risers to a minimum.

Use of Radiography

Quite apart from the use of X-rays in developing foundry technique is the use of radiography in making routine tests of castings produced in mass production lots. Often, castings will have certain particular sections where failures occur most often. If each casting is radiographed at the point in question, the poor castings can be rejected at once, giving assurance to the producer that each of his products is sound.

Of course, the final test of a casting is the way in which it will stand up in use. It is often difficult in reading radiographs, to tell just which defects are really critical. This again is a matter of trial and error.

If castings are marked with a serial number before being put in use, those which fail may be traced back to the foundry where records should be kept on the X-ray examination, casting procedure used, etc. When sufficient records are accumulated, the engineer in charge should be able to determine at once the soundness of a casting in question. In any case, the success which an X-ray testing procedure will attain is largely dependent upon the human element involved in reading the radiographs.

The defects most often occurring in castings are hot tears and cracks, blowholes, sand or slag inclusions, shrinkage cavities, poorly fused chaplets, and pronounced dendritic structure. Each of these will be considered separately.

Hot tears and cracks often have the form of worm holes, being long and fairly wide, although the diameter varies considerably. These cracks are especially objectionable because they have sharp extremities which may exceed the safety allowances of the particular part. They have a tendency to propagate under changes of stress and cause *fatigue failure*. Fatigue failure is progressive and starts when even a minute crack on the surface of the casting is subject to alternate tension and compression or vibration.

Detection of Cracks

The X-ray detection of a crack is often difficult because when the

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plane of the crack is perpendicular to the incoming radiation, the crack will produce very little difference in apparent thickness. However, cracks usually roam from point to point, with changing planes so that at one section or another they will be detected by the X-ray. Experience will help in determining the proper orientation for best results.

Cracks occur in steel in aggregates having a main artery and lesser tributaries which appear much like the lines on a person's hand on the radiographic picture. Smaller cracks may be hard to detect, and sometimes a serious defect will appear to be minor on the radiograph.

Cracks are usually the result of restricted contraction of the metal upon cooling. This is often caused by non-collapsible cores and, therefore, the cracks will usually be located where free dimensional change of the solidifying metal is not possible. Cracks will also occur where sharp corners on castings have not been provided with fillets.

Castings with small internal cracks may be entirely all right for many purposes, but in certain highly stressed parts, such small defects may be highly critical.

Blowholes or porosity are generally round and can easily be recognized on the radiograph. They are found in almost any location on the casting and are usually most prevalent when incorrect pouring temperature or insufficient permeability is used in the foundry technique. The blowholes are sometimes comparatively large, but in some cases they form "microscopic porosity" which would cause a general fogging on the radiograph, which would be difficult to detect.

In aluminum castings, especially, the problem of porosity has caused considerable trouble. Of course, the presence of large blowholes may be a good cause for rejection of certain castings. Where the surface is to be machined, even microscopic porosity might be critical. The seriousness of porosity is largely dependent on the use to which the casting will be put.

Locating Sand Inclusions

Sand inclusions are shown in a radiograph as "granular transparent spots and patches." Generally they will be close to the pouring gate, although they may be present anywhere in the casting. The location of a sand inclusion may be an important consideration on the usability of the casting.

In a highly stressed steam pipe fitting, for instance, a sand inclusion near the inside might be critical because it would interrupt the heat flow to the outside and set up undue strains in the metal. Such a defect near the surface would make little difference. Its location might be determined by stereoscopic technique.

Slag inclusions look much like sand inclusions, although they are generally rounder and have smooth edges. They can easily be avoided with proper foundry technique. Generally, they are near the upper surface of the poured castings. The considerations on the seriousness of sand inclusions hold true for slag inclusions also. Where any machining is to be done, the metal should be entirely free from sand and slag inclusions.

Shrinkage cavities often occur when the feeding of the mold is imperfect. In such a case, the cavity will be near the gate. On the radiograph a cavity will appear as an irregular void.

Pipe or primary shrinkage is caused by poorly functioning risers. A large section fed by smaller sections is likely to have this defect. Pipes are long irregular defects, while cavities usually have a large area with several pipes leading into it.

Formation of Secondary Pipes

Secondary pipes are formed by the flow of metal during the final solidification stage when the channels are constricted. They are usually quite fine. The seriousness of these defects is largely dependent on the particular case.

The outline of poorly fused chaplets will show up on a radoigraph. This defect is a source of failure under stressed conditions and a poorly fused chaplet could not be machined.

A pronounced dendritic structure will show up on a radiograph in the form of fine straight lines in a definite pattern. This structure will occur near sharp corners and is often a cause of cracks.

One of the most important factors influencing the utility of an X-ray picture is that of sensitivity. Sensitivity is the measure of the smallest defect that can be detected for a given object. It is usually expressed as the percentage value of the ratio of the thickness of the smallest detectable defect to the thickness of the object being radiographed.

The two factors which affect or determine sensitivity are the sharpness or detail of the defect under consideration and the contrast or difference in density between the defect and the surrounding background. Each of these two factors will be considered separately.

(A) Factors influencing contrast

The X-ray tube voltage should be kept as low as possible, consistant with a reasonable exposure time. A high voltage tends to cause more secondary radiation which will fog the film and reduce the contrast. The time of correct exposure will then be short enough to be practical and still have good contrast. It is possible that if an extremely long exposure time is used, even though the kilovoltage is low, the fogging of the film, due to secondary radiation, will build up to an undesirable amount because of the long exposure time.

A larger part of the film density is produced by intensifying screens than by the direct X-rays alone. Since the intensifying screen is more sensitive to differences in X-ray intensity, the use of intensifying screens will improve the contrast of a film.

Cones to limit the X-radiation to a smaller area will improve contrast by reducing fogging caused by secondary radiation.

Industrial grids also are very helpful in reducing secondary radiation, and, therefore, fogging, increasing the contrast of the film.

In setting up the original positioning for an X-ray shot, the film should be liberally shielded from any possible secondary radiation, by placing lead sheets in strategic positions where they will absorb unwanted radiation. This is more important than one at first realizes, and may make the difference in poor and good sensitivity. A good rule to follow is: When in doubt, *SHIELD!*

A large number of secondary factors also affect the sensitivity

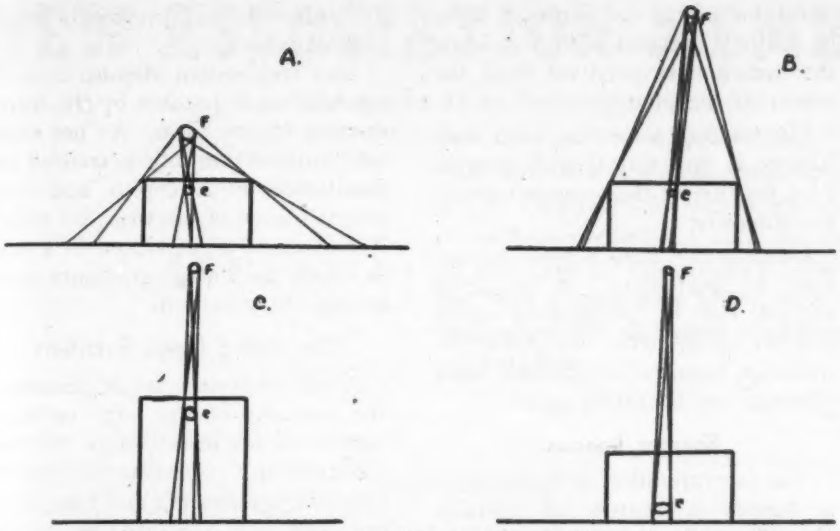

Fig. I—Geometric factors governing detail in a radiograph (Abbott). Shows effect of relative size and location of focal spot on definition. ABCD is specimen. F is focal spot. C is cavity in specimen.

of a film to a great extent. These include the following factors, against which precautions should be taken:

1. Secondary radiation reaching the film while in storage.
2. White light hitting the film, either in the darkroom or while the film is in the cassette.
3. Chemical effects such as chemical fog, caused by poor chemicals or chemical containers which deteriorate; impure city water used to mix the chemicals; insufficient rinsing; old solutions; or incorrect temperature and time control in development.
4. If films are withdrawn from the solutions during development, undesirable oxidation of the developer will take place.
5. All films have an expiration date, beyond which they should not be exposed for best results.

It might be mentioned at this point, while on the subject of contrast, that a limiting factor on the correct selection of the kilovoltage for greatest contrast in a radiograph is that of latitude. If the casting to be radiographed has differences in section thickness, a compromising kilovoltage must be used which will give a satisfactory sensitivity in both sections. It follows that if such a kilovoltage is not attainable, two separate exposures will be required.

(B) Factors influencing sharpness or detail

These factors are largely geometric as shown in Fig. I.*

*Symposium on Radiography, ASTM, p. 10, Fig. 5, 1943 Edition.

In Fig. I, the focal point as shown in each case at "F" and "C" is a defect in the rectangular shaped object. As is evident, better sharpness is possible with greater source to film distance. Also the defect-film distance is important as shown at "D." The detail is so much improved with a very short defect-film distance, that in some cases, such as in very thin spot welds, the source to film distance can be reduced considerably, materially shortening the time required.

The use of a bucky grid will improve the detail as well as the contrast. This instrument, in addition to the metal foil intensifying screen, probably will give the best results as regards sensitivity. Although such practice will take considerably more time, in some cases, the increased sensitivity will make it worth while.

While intensifying screens will improve contrast, the use of fast calcium tungstate intensifying screens will decrease the sharpness. This can be explained when it is remembered that fast screens have larger crystals. Since the whole crystal fluoresces upon receiving radiation, large crystals along the edge of detail will tend to decrease the sharpness.

Use of Gamma Rays

Often, instead of using X-rays in examining castings, gamma rays, which have shorter wavelengths, are used. In this case, a small amount of radium sulfate is used as the source of radiation in taking the picture. The following considerations are involved in a decision as to whether X-rays or radium should be used in making an examination.

The thickness and density of the metal to be examined are major considerations in the choice between gamma rays and X-rays. Waves given off by radium (gamma rays) are in general considerably shorter than X-rays and as a consequence they have better penetrating power.

In 1936, the maximum official thickness that could be penetrated with X-rays was 4¼ in. of steel, a standard set up by the A.S.M.E. Boiler Code Committee. This maximum was the best obtainable with equipment having voltages up to 400,000v. With gamma rays, thicknesses up to 11 in. of steel have been radiographed. Recently the development of the million-volt X-ray has, of course, increased the range of possible thicknesses of X-ray penetration.

Advantage of Range

The sensitivity of gamma rays compares favorably to that of X-rays in thicknesses from 1 to 2½ in., both having a sensitivity of about 2 per cent. However, in thinner sections, X-rays have, no doubt, the better sensitivity; (possibly 1 per cent). Gamma rays, having the shorter wavelengths, have far less scattering than X-rays, which accounts for the good sensitivity for thicknesses over two inches. However, the contrast is a function of the wavelength, so for thinner objects X-rays have a decided advantage since the scattering effect in the thin range is much less.

When gamma rays or X-rays pass through an iron or steel object, there is always considerable scattered radiation. Compton has shown, however, that in the case of gamma rays, this scattered radiation acts right along the line of original radiation, so that it actually helps make a good radiograph. X-rays, on the other hand, scatter through wide angles to a much greater degree. This type of scattering, of course, will cause fogging and reduce the contrast.

Due to the Compton effect, scattered rays are changed in wavelength. The gamma rays undergo an increase of more than 200 per

cent in wavelength. Such long waves are quickly absorbed by the object. X-rays, on the other hand, have only an increase of about 16 per cent, and the scattered rays definitely will affect the film.

In summing up the foregoing considerations, it may be said that in examining thicknesses from 2 to 3 in. of steel, in using X-rays, it would be wise to use a bucky grid to reduce scattered radiation. In using a radium source, the scattering effects may be disregarded entirely.

X-rays are advantageous in examining thin objects (one in. and under), but with ordinary X-ray equipment, thicknesses greater than about 4½ in. of steel are impractical to penetrate.

X-rays, having greater intensity, are much faster than gamma rays, the latter requiring hours of exposure time. Therefore, in routine examination, as in a production foundry or in a welding shop, X-rays are by far more practical.

Gamma rays, however, are given off in all directions. For this reason exposures in different positions may be taken simultaneously. Circular welds on pipes, for instance, may be entirely enclosed with film while the radiation is given off from the center of the pipe.

Fluoroscopy, sometimes used with X-rays, is impractical with gamma rays, because of their comparatively low intensity.

Gamma rays have a great advantage in portability. A piece of radium can be transported easily and set up at once. An X-ray installation requires considerable time, expense, and operating space.

Sharper Images

The interpretation of radiographs is largely a matter of opinion. X-rays, as a rule, give sharper images. However, most users are entirely satisfied with results of proper gamma-ray technique.

Until recently, the thickness of metal which could be examined with X-rays was limited to a few inches. As the voltage of an X-ray tube increases, the possible penetration of the machine increases. A new million-volt X-ray tube was a big step forward in the manufacture of X-ray tubes, since it has a voltage 2½ times that of previously available units.

This tremendous step-up in voltage was made possible by the introduction of new ideas. A "hot cathode, multisection tube permitted the production of a copius and consistent source of electrons by which X-rays could be produced in a tube in which the voltage gradients could be kept to safe limits."

Eliminating Large Rectifiers

A self-rectifying circuit eliminates the necessity of the large rectifiers used in former installations. Air and moisture are completely removed from the transformer and tube housing and are replaced by a gas having very high insulating properties. Sharp images are made possible by a coil which focuses the beam of electrons. This focusing property is also important in that it prevents scattered radiation and eliminates the necessity of extensive shielding.

The whole unit (apart from the control board) is housed in a tank 4 ft. long and 3 ft. in diameter. A projection for the anode increases the total length to about 6 ft.

In taking pictures, the technician operates the unit from a lead lined room. The voltage and current are gradually brought up until the proper exposure has been given.

Thicknesses up to 6 in. are taken in less than 10 min., compared to 5 to 10 days for a similar gamma ray exposure. Sharper images are said to result because of the focusing unit. However, the high voltage decreases contrast.

The million-volt machine is best adapted to examining thicknesses beyond the range of lower voltage installations. For thinner work, ordinary tubes will probably continue to be used.

It is evident that radiography has played an important part in our industry of today, and with the larger, more powerful units now available, its use will be more extensive in the future.

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NEW ASSOCIATION MEMBERS

(November 16 to December 15, 1944)

• As the new Central Ohio Chapter takes its place among other A.F.A. Chapters, it makes its first formal bow in this listing of New Association Members with the fine representation of 34 members, or 15 per cent of the month's total of 218. As the membership roster for 1944 comes to a close, it is fitting that a word of praise be extended to the different Membership Committees for their excellent cooperation.

Conversions from Company to Sustaining

†Baker-Perkins Co., Inc., Saginaw, Mich. (Hans H. Hennecke, Works Manager) (Detroit Chapter—Saginaw Valley Group).
†Eastern Clay Products, Inc., Elfort, Ohio (N. J. Dunbeck, Vice President) (East Central Ohio Chapter).

Sustaining Members

†Benn Iron Foundry, Wallaceburg, Ontario, Canada (Alfred E. Benn, Owner and Manager) (Ontario Chapter).
†California Brass Mfg. Co., Los Angeles, Calif. (Loren E. Raymond, Partner) (Southern California Chapter).
†Swedish Crucible Steel Co., Detroit, Mich. (Norman N. Olson, V.P. & G.M.) (Detroit Chapter).

BIRMINGHAM CHAPTER

Sam F. Carter, Jr., Asst. Melting Supt., American Cast Iron Pipe Co., Birmingham.
Samuel E. Davis, Cupola Foreman, American Casting Co., Birmingham.
Dan O. Turner, Sales Engineer, Laclede-Christy Clay Products Co., Chattanooga, Tenn.

CANTON DISTRICT CHAPTER

Harvey N. Bell, American Steel Foundry, Alliance, Ohio.

CENTRAL INDIANA CHAPTER

Carl E. Appelquist, Sales Repr., Wisconsin Steel Co., Chicago.
Raymond Cline, Gen. Mgr., B. & B. Foundry, Indianapolis, Ind.
Floyd Miller, Core Room Foreman, Indianapolis Brass & Aluminum Foundry, Inc., Indianapolis.
Thomas W. Moore, Foreman, National Malleable & Steel Castings Co., Indianapolis.

CENTRAL OHIO CHAPTER

W. T. Berry, Melter Foreman, The Alloy Cast Steel Co., Marion, Ohio.
F. C. Carey, Foundry Foreman, The Alloy Cast Steel Co., Marion.
Dillon Clay, Core Foreman, Ohio Steel Foundry, Springfield, Ohio.
Chas. M. Craighead, Research Engr., Battelle Memorial Institute, Columbus.
Donald Currey, Supt., Fahrite Dept., Ohio Steel Foundry Co., Springfield.
W. L. Deutsch, Columbus Malleable Iron Co., Columbus.
Harold W. Doty, Pattern Dept., Ohio Stove Co., Portsmouth.
Joe L. Dupler, Foundry Supt., Alten's Foundry & Machine Works, Lancaster.
R. M. Evans, Supt., The May-Fieberger Co., Newark.
J. B. Ferguson, Chemist, The Alloy Cast Steel Co., Marion.
Fred W. Fuller, Field Engr., National Engineering Co., Columbus.
Jack E. Gickler, Asst. Supt., The Alloy Cast Steel Co., Marion.
Luther C. Hamblin, Supv., Ohio Stove Co., Portsmouth.
Albert J. Hess, Supv., Ohio Steel Foundry Co., Springfield.
Hubert V. Hites, Asst. Plant Supt., Ohio Steel Foundry Co., Springfield.
William J. Howard, Columbus Malleable Iron Co., Columbus.
***The Keener Sand & Clay Co., Columbus (E. M. Durstine, Gen. Mgr.).**
George D. Keeney, Student, Ohio Stove Co., Portsmouth.
H. B. Kinnear, Asst. Supv., Battelle Memorial Institute, Columbus.
George P. Krumlauf, Research Engr., Battelle Memorial Institute, Columbus.
Floyd O. Lemmon, Melting Supt., Ohio Steel Foundry Co., Springfield.
Morris K. Matteson, Asst. Foreman, The Alloy Cast Steel Co., Marion.
Elden McCarty, Prod. Supt., H. B. Salter Mfg. Co., Marysville.
Ray Meyer, Supv., Sand, Ohio Steel Foundry Co., Springfield.
Walter A. Monnette, Res. Engr., Battelle Memorial Institute, Columbus.
Albert N. Moon, Core Dept. Foreman, The Alloy Cast Steel Co., Marion.
Wm. J. Parham, Molding Foreman, Ohio Steel Foundry Co., Springfield.
R. O. Poling, Master Mechanic, The Alloy Cast Steel Co., Marion.
***The Pyro Clay Products Co., Oak Hill, Ohio (O. E. Miller, Pres.).**
Larry A. Starrett, Chemist, International Derrick & Equipment Co., Columbus.
M. A. Van Schoyck, Gen. Foreman, Ohio Steel Foundry Co., Springfield.
George F. Warnek, Gen. Foreman, Ohio Steel Foundry Co., Springfield.
Louis E. Welch, Sr., Research Met., The Ohio Steel Foundry Co., Springfield.
G. J. Wilhelm, Asst. Cleaning Room Foreman, The Alloy Cast Steel Co., Marion.

* Company Members
† Sustaining Members

CHESAPEAKE CHAPTER

William J. Herbert, Chemist & Asst. Met., York Corp., York, Pa.

CHICAGO CHAPTER

Herbert C. Aamodt, Melter, National Malleable & Steel Casting Co., Melrose Park, Ill.
Robert A. Aeberly, Tech. Sales & Service Repr., Electro Metallurgical Sales Corp., Chicago.
C. T. Brewer, Engr., Webster Products, Chicago.
J. Curto, Plant Supt., Acme Aluminum Foundry Co., Chicago.
Dr. Elton A. Darling, Research Chemist, Lauhoff Grain Co., Danville, Ill.
Gilbert R. Finch, Dodge Chicago Plant, Chrysler Corp., Chicago.
Charles A. Flatray, Foreman, Pettibone, Mulliken Corp., Chicago.
John D. Goddard, Foreman, Pettibone, Mulliken Corp., Chicago.
Rudolph Josephson, Gen. Foreman, Link-Belt Co., Chicago.
John P. Lubenkov, Gen. Foreman, Link-Belt Co., Chicago.
Ellis C. Lyons, Designer, Howard Foundry Co., Chicago.
John Macdonald, Pattern Shop Foreman, Pettibone, Mulliken Corp., Chicago.
L. J. Mayer, Repr., Superior Steel & Malleable Castings Co., Chicago.
Edwin H. Nelson, Industrial Pattern Works, Chicago.
Bert O'Hare, Supt., Iron Foundry, Western Foundry Co., Chicago.
John E. O'Neill, Foreman, Pettibone, Mulliken Corp., Chicago.
Roy W. Olsen, Dist. Sales Mgr., Alloy Metal Abrasive Co., Chicago.
Albert Retis, Foreman, Dodge Chicago Plant, Chrysler Corp., Chicago.
F. J. Sherwin, Vice Pres., The Chicago Hardware Foundry Co., North Chicago.
Albert Spina, Foreman, Pettibone, Mulliken Corp., Chicago.

DETROIT CHAPTER

Edward A. Bertrand, Owner, Williams Foundry, Detroit.
Robert E. Conover, Student, University of Michigan, Ann Arbor, Mich.
A. E. DeClercq, Met., Lauhoff Grain Co., Detroit.
Don M. Ferris, Fdry. Supt., Budd Wheel Co., Detroit.
Ford Motor Co., Rouge Plant, Ford Aircraft School, Dearborn, Mich.
Charles E. Kelley, Steel Melter, Ford Motor Co., Dearborn.
***J. O. Stephenson Foundry & Mfg. Co., Detroit (J. O. Stephenson, Owner).**

DETROIT CHAPTER—SAGINAW VALLEY GROUP

Edw. L. Burnett, Foreman, Dow Chemical Co., Bay City, Mich.
David T. Martin, Sales Dept., Saginaw Malleable Iron Div., G.M.C., Saginaw.
Floyd Parker, Core Room Chief Inspector, Chevrolet Grey Iron Foundry, Saginaw.
William H. Shea, Supv., Standards Dept., Saginaw Malleable Iron Div., G.M.C., Saginaw.

EASTERN CANADA & NEWFOUNDLAND CHAPTER

***Acme Pattern Works Ltd., Montreal, Que., Canada (Reginald Parker, Pres.).**
P. Claes, Core Room Foreman, Canadian Car & Foundry Co., Ltd., Montreal, Que.
Jack Crawley, Robert Mitchell Co., St. Laurent, Que.
William Forrest, Patt. Shop Foreman, Robert Mitchell Co., St. Laurent, Que.
Romeo Soyette, Dominion Engineering Co., Ltd., Lachine, Que.
Leopold A. Jean, Robert Mitchell Co., St. Laurent, Que.
Marcel Livernois, Core Room Inspection, Robert Mitchell Co., St. Laurent, Que.
***Melanson's Foundry, Montreal, Que. (Marc Melanson, Prop.).**
Edgar Robitaille, Foreman, Canadian Pattern & Woodworking Co., Montreal, Que.

METROPOLITAN CHAPTER

D. Wesley Case, Foundry Supt., Belknap Mfg. Co., Bridgeport, Conn.
***The Cooper Alloy Foundry Co., Hillside, N. J.**
John Fecko, Gen. Foreman, Worthington Pump & Machine Co., Harrison, N. J.
John W. Friedrick, Converter Blower, Worthington Pump & Machine Co., Harrison, N. J.
Robert E. Hempel, Plant Mgr., Cooper Alloy Foundry Co., Hillside, N. J.
Alfred J. Howarth, Supt., Eclipse-Pioneer Foundries, Teterboro, N. J.
Carl J. Jernstrom, Vice Pres., Cooper Alloy Foundry Co., Hillside, N. J.
John Wm. Lathen, Jr., Sand Chemist, Eclipse-Pioneer Foundries, Teterboro, N. J.
James Quigley, Sr., Foundry Supt., The Cooper Alloy Foundry Co., Hillside, N. J.
Kenneth W. Rhoads, Sales Engr., Kuhlman Electric Co., New York City.
A. J. Schmidt, Engr. Die Casting & Permanent Mold, Eclipse-Pioneer Foundries, Teterboro, N. J.
Ralph D. Speirs, Pattern Supt., Wright Aeronautical Corp., Paterson, N. J.

MICHIANA CHAPTER

John P. Jordan, Foundry Engr., Dodge Mfg. Corp., Mishawaka, Ind.
Leonard J. Klinke, Bendix Products Corp., South Bend, Ind.
James C. Leeds, Prod. Engr., Josam Products Foundry Corp., Michigan City, Ind.
John H. MacDonald, Round Oak Co., Dowagiac, Mich.
Lawrence B. Randall, Superior Brass & Mfg. Co., Elkhart, Ind.
B. J. Waite, Core Foreman, Josam Products Foundry Co., Michigan City, Ind.

NORTHEASTERN OHIO CHAPTER

Walter C. Kremser, Sales Engr., Forest City Foundries, Cleveland.
Fred Ruffolo, Industrial Engineer, Dailey, Brenner & Schreiber, Cleveland.
A. O. Snyder, Dist. Repr., Calder Mfg. Co., Cleveland.
Harold A. Stouck, Ceramic Engr., Perth Amboy, N. J.

NORTHERN CALIFORNIA CHAPTER

Laird Gale, X-ray Technician, Columbia Steel Co., Pittsburg, Calif.
Fred A. Granucci, Foreman, Core Room, Greenburg's Sons, San Francisco.
John W. Hallberg, Coremaker, General Metals Corp., Oakland.
William Hinde, Molder, M. Greenberg's Sons, San Francisco.
Cheng P. Hsich, Molder Apprentice, H. C. Macaulay Foundry Co., Berkeley.
Stanley Cynn, Engr., Joshua Hendy Iron Works, Sunnyvale.
George H. Quick, Foundry Inspector, Columbia Steel Co., Pittsburg.

ONTARIO CHAPTER

Alfred Serjeant, Owner, Zenith Alloys Co., Brantford, Ont.
Russell G. Thompson, Sr., Owner-Mgr., Acme Pattern Works, Toronto, Ont.
***Wilson Brass & Aluminum Foundries, Toronto, Ont. (L. Wilson, Supt.).**

PHILADELPHIA CHAPTER

Lt. Enrique Cavada, Chilean Navy, Philadelphia.
M. J. Compty, Sales, Chicago Pneumatic Tool Co., Philadelphia.
John Davis, Salesman & Demonstrator, O. F. Zurn Co., Philadelphia.
R. B. Harrison, Gen. Agent, Microtecnica Ltd., Reading, Pa.
***O. F. Zurn Co., Philadelphia (O. F. Zurn, Treas.).**

QUAD-CITY CHAPTER

E. H. Buller, Timestudy Engr., J. I. Case Co., Rock Island, Ill.
***Climax Engineering Co., Clinton, Iowa (Charles Deubner, Fdry. Supt.).**
J. C. Fye, Chief Inspector, Union Malleable Iron Co., East Moline, Ill.
John C. Keil, Foundry Foreman, Climax Engineering Co., Clinton, Iowa.
Edward F. Moore, Molder, Ordnance Steel Foundry Co., Bettendorf, Iowa.
David M. Sandberg, Foundry Supt., Sandberg & Sons Foundry, Moline, Ill.
Paul L. Sandberg, Treasurer, Sandberg & Sons Foundry, Moline, Ill.

ROCHESTER CHAPTER

Frederick O. E. Raab, Principal, Paul Revere Trade School, Rochester, N. Y.

ST. LOUIS DISTRICT CHAPTER

James C. Carnes, Gen. Foundry Foreman, Walworth Co., Washington Park, Ill.
Al Clemens, Core Room Foreman, National Foundry & Machine Co., St. Louis.
Harry B. Frank, Sample Expediter, Key Co., East St. Louis, Ill.
Ernest R. Grammer, Pattern Checker, Key Co., East St. Louis, Ill.
Wm. K. Hansen, Met., McQuay-Norris Mfg. Co., St. Louis.
Alfred F. La'Bee, Quality Control Mgr., National Foundry & Machine Co., St. Louis.
Gilbert B. Moss, Foreman, Key Co., East St. Louis, Ill.
William A. Renz, Gen. Foreman, Key Co., East St. Louis, Ill.
George W. Shepherd, Foundry Foreman, Key Co., East St. Louis, Ill.
John S. Swanson, Asst. Met., Key Co., East St. Louis, Ill.

SOUTHERN CALIFORNIA CHAPTER

Blaine Bender, Office Mgr., Advance Aluminum & Brass Co., Los Angeles.
Erick L. Berdah, Finishing Room Foreman, American Foundry, Los Angeles.
Norval F. Carter, Foundry Foreman, American Foundry, Los Angeles.
Warren K. Clapp, Warren Foundry & Machine Co., Los Angeles.
Lester Ennis, Manager, Fundicion de Fierro de Guanajuato, Guanajuato, Gto., Mexico.
Pascual Estrade, Foundry Foreman, California Brass Mfg. Co., Los Angeles.
William H. Hallford, Core Room Foreman, American Foundry, Los Angeles.
D. F. Hand, Sales Mgr., Rabun Bronze Foundry, Inc., Huntington Park.
Fred C. Lutts, Foundry Foreman, D. & M. Machine Works, Torrance.
Dwight L. Palmer, Gen. Mgr., American Foundry, Los Angeles.
John V. Wilson, Personnel & Office Mgr., American Foundry, Los Angeles.

TOLEDO CHAPTER

James De Witt, Cleaning Dept. Supt., Unitcast Corp., Toledo.
Robert H. Mouch, Asst. Chief Inspector, Unitcast Corp., Toledo.

TWIN-CITY CHAPTER

***Alloy Metals Co., St. Paul, Minn. (H. B. Hoeschen, Asst. to President).**
Fred Boelter, Night Supt., American Hoist & Derrick Co., St. Paul.
S. L. Cameron, Jr., Vice Pres., Valley Iron Works, St. Paul.
H. P. Everson, Core Room Foreman, Western Alloyed Steel Casting Co., Minneapolis.
***Fergus Foundry Co., Div. of the Adelsman Co., Fergus Falls, Minn. (LeDue G. Adelsman, General Manager).**
Walter J. Gideon, Shipping Clerk, Midway Iron Works, St. Paul.
***Hart-Carter Co., Minneapolis (Kelvin Denike, Manager).**
Albert F. Hauser, Shop Foreman, Midway Iron Works, St. Paul.
Nathan Levinson, Fdry. Met., Minneapolis-Moline Power Implement Co., Minneapolis.
Edward E. Mueller, Foundry Sales Mgr., Diamond Iron Works, Minneapolis.
***National Foundry Co., Minneapolis (William Herkal, Partner).**
John J. Petrie, Bookkeeper, National Foundry Co., Minneapolis.
Knox A. Powell, Research Engr., Minneapolis-Moline Power Implement Co., Minneapolis.
Walter J. Reutiman, Partner, National Foundry Co., Minneapolis.
M. E. Seaquist, Office Mgr., Paul Pufahl & Son Foundry, Minneapolis.
Thomas Spencer, Foundry Supt., The Dotson Co., Mankato, Minn.
Dean Thom, Salesman, E. R. Frost Co., Minneapolis.
***Waterman-Waterbury Co., Minneapolis (E. L. Schneider, Supt.).**
Thomas J. Wukawitz, Partner, Midway Iron Works, St. Paul.

WESTERN MICHIGAN CHAPTER

Carl A. Anderson, Foundry Foreman, Centrifugal Casting Co., Muskegon.
J. J. Bigge, Asst. Treasurer, C.W.C. Foundry Co., Muskegon.
***Centrifugal Machine & Engineering Co., Kalamazoo (W. S. Bingham, Pres.).**
Clarence Cobb, West Michigan Steel Foundry Co., Musckegon.
Jack Eurich, Chemist, Centrifugal Casting Co., Muskegon.
Herman Friesema, Pres., Muskegon, Pattern Works, Muskegon.
Frank Galoit, Jr., West Michigan Steel Foundry Co., Muskegon.
Henry F. Gruen, Foreman, Dake Engine Co., Grand Haven.
Paul Kiefer, West Michigan Steel Foundry Co., Muskegon.
Ernest R. Olsen, Research, Clover Foundry Co., Muskegon.
James Ribbink, Foreman, Dake Engine Co., Grand Haven.
Simon Vallenga, Inspection Foreman, Clover Foundry Co., Muskegon.

WESTERN NEW YORK CHAPTER

Thomas J. Caffrey, Sand Technician, Symington-Gould Corp., Depew, N. Y.
G. Norman Frederickson, Sales Engr., The Hanna Furnace Corp., Buffalo.
University of Buffalo, Lockwood Memorial Library, Buffalo.
Frank J. Weber, Repr., American Air Filter Co., Buffalo.

WISCONSIN CHAPTER

***Aluminum Casting & Engineering Co., Milwaukee (John T. Watry, Pres.).**
Lyle H. Brogley, Asst. Foundry Met., International Harvester Co., Milwaukee.
Odel Gleaton, Core Room Foreman, Allis-Chalmers Mfg. Co., West Allis.
John Heun, Pres., Art Pattern Works, Inc., Milwaukee.
William C. Long, Sales Engr., Lauhoff Grain Co., Kenosha.
J. B. Mueller, Johnson Service Co., Milwaukee.
Fred A. Osterman, Night Foundry Supt., International Harvester Co., Milwaukee.
Clarence Schmidt, Molding Foreman, Allis-Chalmers Mfg. Co., West Allis.
Edwin R. Shorey, Prof. of Mining & Metallurgy, University of Wisconsin, Madison.
Hans H. Stobbe, Partner, Art Pattern Works, Inc., Milwaukee.

OUTSIDE OF CHAPTER

James G. Cametti, Engr., Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Frank A. Ceratsky, Core Room Foreman, Northwest Foundry, Portland, Ore.
Linwood Demey, Vermont Foundries, Inc., Springfield, Vt.
Bernard R. Drake, Development Engr., Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Edward A. Fox, Engr., Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Clarence Harold Johnson, Jr., Engr., Met., Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Paul J. Murphy, Vermont Foundries, Inc., Springfield, Vt.
Walter V. Oden, Shipping Clerk, Western Industrial Supply Co., Portland, Ore.
Charles Olberding, Molder, Pacific Steel Foundry, Portland, Ore.
Dana E. Olden, Vermont Foundries, Inc., Springfield, Vt.
***Oregon Steel Foundry Co., Portland, Ore. (F. W. Matthews, Mgr.).**
Edwin V. Prehn, Partner, Wm. Prehn & Son., Portland, Ore.
Frank Herbert Richards, Machine Molding Foreman, Thames, New Zealand.
Gordon Ronken, Engr., Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
***Rushlight Steel Works, Portland, Ore. (Wm. J. Carnese, Supt.).**
Roy Lee Simpson, Foundry Foreman, Oregon Steel Foundry Co., Portland, Ore.
J. L. Snyder, Shipping Clerk, Northwest Foundry, Portland, Ore.
Raymond M. Wilson, Lead Molder, Pacific Steel Foundry Co., Portland, Ore.
Ralph E. Wright, Supt., North West Stove Foundry, Portland, Ore.

CHAPTER ACTIVITIES

News

See page 27 for list of Chapter representatives whose reports of local activities appear in this issue.

WESTERN NEW YORK CHAPTER

Hears W. H. Gunselman Discuss Aluminum

By J. Ralph Turner

MEMBERS of the Western New York Chapter held a regular monthly meeting, December 1, at the Hotel Touraine, Buffalo, with Wayne H. Gunselman, National Bronze & Aluminum, Cleveland, featured as the main speaker. Technical Chairman Harold R. King, Metal & Alloy Specialties Co., Inc., Buffalo, introduced Mr. Gunselman, who discussed "Advantages of Aluminum Alloy."

The speaker stated that during the last few years foundry practice with aluminum has changed from manufacturing of ornamental, non-functional and non-stressed parts to parts used in the most intricate and exacting functions in the ultimate state. Where safety factors of ten to one were a rule a few years ago, safety factors as low as three and four to one are now common practice.

In order to produce these castings, absolute control of all procedures is necessary, including charging, melting and pouring practices, core and molding sand mixtures, heat treating, impregnating, welding, peaning and pressure testing; likewise all raw material entering the plant should be controlled.

The speaker disagreed with the belief some people subscribe to, that the present exacting specifications which call for rigid control are wartime measures only and will be completely relaxed after the war. He stated that specifications will be even more rigid after the completion of this war due to the fact that the aircraft industry, automotive industry and marine industries will continue changes inaugurated before and during the war with tendency to reducing weight and increasing efficiency, which will cause further development in the aluminum and magnesium foundries.

In the speaker's own plant a large force of inspectors is employed to make sure that procedure set up by the laboratory foundry is carried out in production.

Chairman Reinhold D. Loesch, Lake Erie Foundry Co., Buffalo, introduced N. F. Hindle, Director of the A.F.A. Technical Development Program, Chicago. Mr. Hindle disclosed that one of the objectives of the Technical Development Program is to build a complete library of foundry information. He also announced that the 5th revised edition of the A.F.A. Sand Testing Book is now available for distribution.

Prior to the talks of the evening, Martin W. Pohlman, Pohlman Foundry Co., Inc., Buffalo, was presented with a Past Chairman Pin by the immediate Past Chairman Frank E. Bates, Worthington Pump & Machinery Corp., Buffalo.

James L. Yates, Worthington Pump & Machinery Corp., Buffalo, reported that it had been decided to continue the formation of a Technical Societies Council for the Niagara Frontier Area. He also reported on continued cooperation between the

Chapter Chairman F. M. Wittlinger, Texas Electric Steel Casting Corp., Houston, speaks to the dinner group at the October 12 roundtable meeting at the Golfcrest Country Club, Houston.

chapter and the newly formed Engineering School of the University of Buffalo. Efforts will be made to see that current literature on foundry practice is made available for the work of the school.

Chesapeake Presents Pins to Past Chairmen

By E. J. Hubbard

CHAPTER Chairman H. A. Horner, Frick Co., Inc., Waynesboro, Pa., opened the Chesapeake Chapter meeting held at the Engineer's Club, Baltimore, November 17. J. A. Gitzen, Delta Oil Products Co., Milwaukee, the speaker of the evening, was introduced by Philadelphia Chapter Director Herman Mandel, Pennsylvania Foundry Supply & Sand Co., Philadelphia.

Mr. Gitzen, in his review of core problems, emphasized the role played by moisture in the baking of cores, and cited an instance where a core containing 8 per cent water was baked for 8 hours and never exceeded 215° F. (the boiling point of water being 212° F.). This core became hard when it was removed to the atmosphere because the surface oxidized; the center, of course, was still green.

Prior to the main talk, Chapter Director Earl J. Bush, U. S. Navy Yard, Washington, D. C., in behalf of the members, presented distinguished service pins to Past Chairmen J. E. Crown, U. S. Navy Yard, Washington, D. C.; R. T. Covington, American Hammered Piston Ring Div., Koppers Co., Baltimore; and E. W. Horlebein, Gibson & Kirk Co., Baltimore. The pins were given to these three men by the members, as a token of appreciation for the time and labor spent in making the Chesapeake Chapter a success.

Because of the advance of dates, the meeting was held in the main hall through the cooperation of the Welding Society.

Government Research Discussed at E. Canada

By G. Ewing Tait

THE Eastern Canada and Newfoundland Chapter held a well-attended meeting in the Mount Royal Hotel, Montreal, November 20, with Chapter Chairman R. Bernard, La Cie J. A. Gosselin, Ltee., Drummondville, Que., presiding.

Herbert H. Fairfield, Physical Metallurgy Research Laboratories, Ottawa, was the speaker, and his talk centered about the Canadian Government's new Foundry Research Laboratory. When Canadian manufacturers were faced with a number of metallurgical problems, the Government appropriated $1,500,000 for broadening the facilities of the Government Mines Branch Laboratories.

During the past five years the Laboratories have worked successfully on castings for aircraft, tanks, torpedoes, mortars and guns, as well as a number of other applications. In many cases they have been able to recommend the substitution of castings for difficult and expensive forgings.

The Foundry Research Laboratory is equipped to melt and cast any kind of metal in amounts ranging from 1 oz. to 500 lb. Among the furnaces is a 50-lb. capacity, low frequency induction furnace for melting in a vacuum, or under any desired gas. The laboratory is used in the development of new alloys, experimental work in the production of castings, and experimental work on mold materials.

Harry C. Orr Speaks to Quad City Group

By H. L. Creps

HARRY C. ORR, C. O. Bartlett & Snow Co., Cleveland, was the speaker at the Quad City Chapter meeting, held November 20 at Fort Armstrong Hotel, Rock Island, Ill., with Chapter Chairman R. E. Wilke, Deere & Co., Moline, Ill., presiding.

Eighty-seven members and guests were present to hear Mr. Orr discuss

J. A. Gitzen (left), Delta Oil Products Co., Milwaukee, was guest speaker at the Chesapeake Chapter's November 17 meeting, when distinguished service pins were presented to the group's past chairmen. H. A. Horner, Frick Co., Inc., Waynesboro, Pa., the present chairman, looks on as Chapter Director E. J. Bush, U. S. Navy Yard, Washington, congratulates two former leaders: E. W. Horlebein, Gibson & Kirk Co., Baltimore, and J. E. Crown, U. S. Navy Yard, Washington.

The usual good fellowship prevailed at the Saginaw Valley December 7 meeting, when L. A. Danse, General Motors Corp., was guest speaker. He is seen (right-hand photo) talking with Chapter Chairman Charles Morrison, Saginaw Malleable Iron Div., General Motors Corp.

the subject, "Sand and Mold Handling in Foundries." Many slides were shown, illustrating different types of installations for mold shakeout, sand handling, sand conditioning, mold conveyor systems and dust exhaust systems. The speaker stated that an installation of mechanical equipment usually pays for itself in three years.

In the discussion which followed, Mr. Orr stressed the economy in purchasing substantial equipment and the necessity for proper maintenance. The importance of this was emphasized by the handling of 13-ton molds on conveyors. The speaker also discussed advantages of the loop-type of mold conveyor.

Rochester Visits X-ray Laboratory

By Donald E. Webster

"X-RAY and Its Application in the Foundry" was the subject presented to the large group attending the Rochester Chapter meeting, held at the University of Rochester, N. Y., on November 10.

Herbert Mermagen, University of Rochester, Industrial X-ray Division, was the speaker and reviewed the history of X-ray and showed slides of some of the earliest X-ray exposures. The speaker explained how this method of non-destructive inspection could be used effectively in the foundry to study the effect of variously placed and variously designed gates and risers.

At the close of the regular meeting the members and guests studied the complete facilities of the Industrial X-ray Laboratory. This inspection included the equipment for handling and examining castings, as well as the 1,000,000-volt X-ray unit.

R. L. Lee Discusses Costs at Michiana

By C. W. Petersen

"COSTS and Cost Methods" was selected by R. L. Lee, Grede Foundries Inc., Milwaukee, for his talk at the Michiana Chapter meeting held in South Bend, December 5.

Mr. Lee, Chairman Foundry Cost Committee, was introduced by Martin J. Lefler, Strom Brass Foundry, Elkhart, Ind. During his talk, the speaker stressed the importance of knowing the cost of production on every casting, rather than an average cost per lb. on a group of castings. Also, it is just as vital for the "captive" foundry to know its costs as the "jobbing" foundry. The

These camera studies show members and guests at the Birmingham Chapter's December meeting, held at the Tutwiler Hotel. In the upper photo, Chapter Chairman J. T. Gilbert, Stockham Pipe Fittings Co., Birmingham, is seen with Dr. Jas. S. Vanick, International Nickel Co., New York, guest speaker, and Dr. Jas. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Chapter Program Chairman.

speaker emphasized the greater importance of costs in the coming "buyers" market which is beginning to replace the present "sellers" market. Mr. Lee refuted the idea that some foundries are too small to have a cost system.

Prior to the main speech, with Chapter Chairman V. C. Bruce, Buckeye Products Co., Elkhart, Ind., presiding, a preview of Christmas was displayed by the many colorful and practical gifts presented to those having their names drawn.

The meeting concluded with the showing of a war film in support of the 6th War Loan Drive, which made the 95 members and guests present realize that the foundries still have a big job to do.

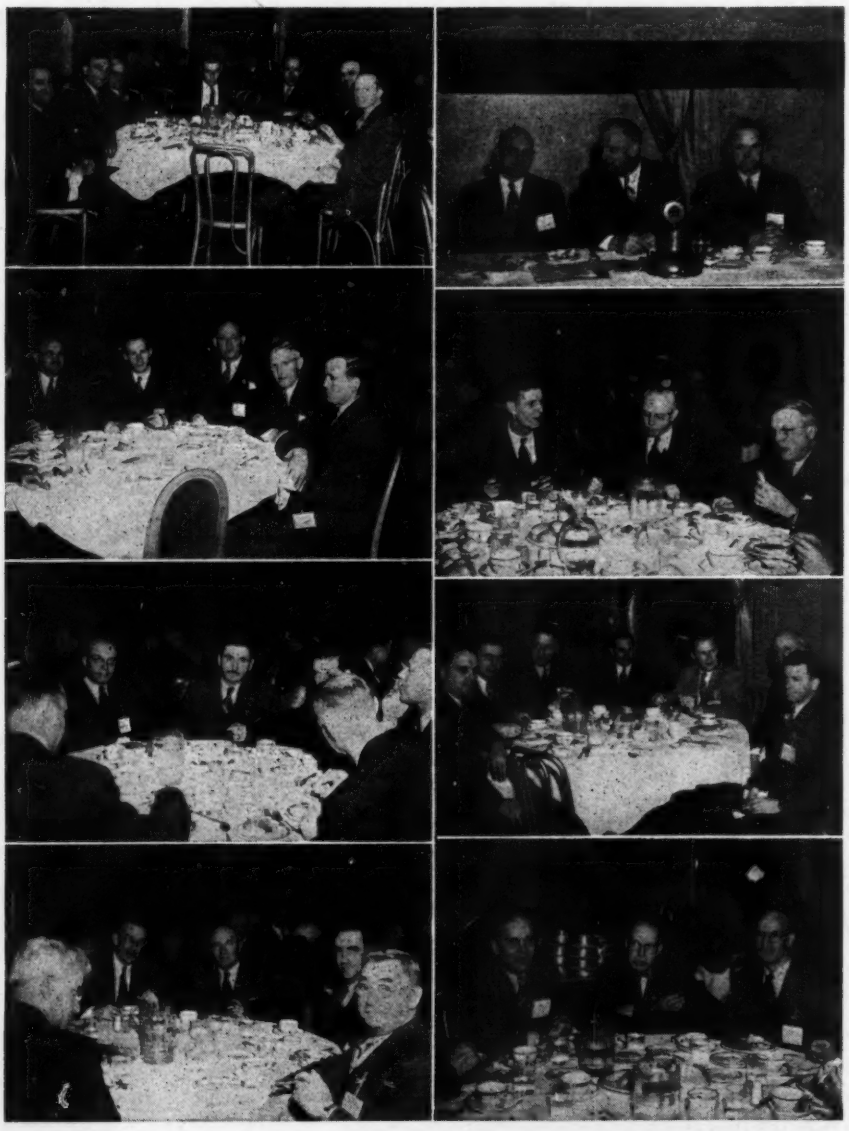
N. Illinois-S. Wisconsin Annual Christmas Party

OVER 400 members and guests attended the annual Christmas dinner party of the Northern Illinois and Southern Wisconsin Chapter, held at Hotel Faust, Rockford, Ill., December 9.

Much of the credit for the success of the party is due to the Christmas Party Committee composed of the following:

General Chairman, R. D. Baysinger, Geo. D. Roper Corp., Rockford, Ill.; entertainment, J. C. Gore, Werner G. Smith, Div. Archer-Daniels-Midland Co., Chicago; tickets, Glen F. Smith, Mattison Machine Works, Rockford; dinner, O. W. Josephson, S. Obermayer & Co., Chicago; and publicity and program, H. W. Miner, Fairbanks Morse & Co., Beloit Wis.

Festivities began from the time the first coat was checked, and continued throughout the dinner which was served family style. Five acts of professional talent climaxed the program.



(Photos courtesy John Bing, A. P. Green Fire Brick Co.)

A fine representation of members and guests of the Wisconsin Chapter met at the Schroeder Hotel, November 10, to hear Lee H. Hill, Allis-Chalmers Mfg. Co., Milwaukee, discuss "Management's Rights and How to Retain Them." Mr. Hill is seen at the speaker's table (upper right-hand photo) with Chapter President Harry E. Ladwig, also of Allis-Chalmers Mfg. Co., and Chapter Director G. K. Dreher, Ampco Metal, Inc., Milwaukee.

"Future of Castings" Is Saginaw Subject

By Joseph J. Clark

THE third regular meeting of the Saginaw Valley Section of Detroit Chapter was held at Fischer's Hotel, Frankenmuth, Mich., December 7 with L. A. Danse, Chairman of the Metallurgical Standards Committee for General Motors Corp., as the speaker.

In his subject, "The Future of the Casting Industry," Mr. Danse drew from his 25 years' experience as Chief Metallurgist at the Cadillac Motor Co. According to the speaker, the foundry business must appeal to energetic and intelligent young men and must have their older men teach the young men and stimulate their interest in the craft.

The speaker urged that foundrymen study their troublesome castings and discuss them with the engineers, rather than take a job that is difficult and struggle with it. Many times close cooperation and exchange of ideas with the engineer has resulted in a good streamlined casting, easier to produce and saleable at a lower price, and cost often determines whether the casting can compete with stampings, forgings and plastics.

The speaker concluded with the suggestion that the various chapters of A.F.A. could do much to encourage young men to enter the foundry field.

J. A. Gitzen Speaks to New England Group

By Merton A. Hosmer

THE regular monthly meeting of the New England Foundrymen's Association was held at the Engineer's Club, Boston, November 8,

with over 100 members and guests present.

"Cores, Core Binders and Core Washes" was the subject chosen by the speaker, J. A. Gitzen, Delta Oil Products Co., Milwaukee. Mr. Gitzen outlined the principal factors in the manufacture of cores as follows: binders, oven conditions, moisture, sand and washes.

He classified binders as organic binders, which completely decompose under temperatures of 1000° F., and inorganic binders, which do not burn until higher temperatures are reached. The speaker stressed the importance of oven conditions in obtaining a properly baked core; the importance of selecting the proper sand for finish and collapsibility; and the functions of core washes.

Prior to the principal address, Leo C. Renaud, Area Training Supervisor, Department of Education of Massachusetts, outlined briefly in behalf of the War Manpower Commission, the educational and training opportunities available in and around Boston.

So. California Names a New Vice-Chairman

By H. E. Russill

APPROXIMATELY 100 members and guests attended the regular meeting of the Southern California Chapter, held at the Clark Hotel, Los Angeles, November 17, to hear L. P. Robinson, Werner G. Smith Co., Cleveland. A lively discussion followed Mr. Robinson's interesting talk on "Variables in the Core Room—Their Treatment and Cure."

Because of the resignation of E. M. Hagener, General Metals Corp., Los Angeles, as Vice-President, Robert R. Haley, Advance Aluminum & Brass Co., Los Angeles, was advanced to Vice-President, and Wm. D. Emmett, Los Angeles Steel Casting Co., Los Angeles, was advanced to Treasurer. Harold G. Pagenkopp, Angelus Pattern Works, Huntington Park, Calif., was elected to the Board of Directors to fill the vacancy created by the advancement of Mr. Emmett.

Reports on Chapter Activities

Officers and representatives of A.F.A. chapter and other foundry groups who report on local activities in this issue, are identified below:

Birmingham—J. P. McClendon, Stockham Pipe Fittings Co., Birmingham; Chapter Reporter.

Canton District—Nils E. Moore, Wadsworth Testing Laboratory, Wadsworth, Ohio; Chapter Reporter.

Chesapeake—E. J. Hubbard, Koppers Co., Baltimore, Md.; Chapter Reporter.

Eastern Canada and Newfoundland—G. Ewing Tait, Dominion Engineering Works, Lachine, Que.; Chapter Vice-Chairman.

Michiana—C. W. Petersen, Dodge Mfg. Co., Mishawaka, Ind.; Chapter Director.

New England Foundrymen's Assn.—M. A. Hosmer, Hunt-Spiller Mfg. Corp., Boston; Group Reporter.

Northern California—Richard Vosbrink, Berkeley Pattern Works, Berkeley; Chapter Reporter.

No. Illinois-So. Wisconsin—R. W. Mattison, Mattison Machine Works, Rockfort, Ill.; Chapter Chairman.

Philadelphia—B. A. Miller, Cramp Brass & Iron Founders Div., Baldwin Locomotive Works, Eddystone, Pa.; Chapter Director.

Quad City—H. L. Creps, Frank Foundries Corp., Moline, Ill.; Chapter Secretary-Treasurer.

Rochester—D. E. Webster, American Laundry Machinery Co., Rochester, N. Y.; Chapter Secretary-Treasurer.

Saginaw Valley—J. J. Clark, Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich; Chapter Reporter.

Southern California—H. E. Russill, Eld Metal Co., Ltd., Los Angeles; Chapter Vice-President.

Toledo—G. W. Buchanan, Unitcast Corp., Toledo; Chapter Reporter.

Twin City—Alexis Caswell, Manufacturers' Association of Minneapolis, Inc., Minneapolis; Chapter Secretary-Treasurer.

Western New York—J. Ralph Turner, Queen City Sand & Supply Co., Buffalo; Chapter Secretary.

(Photos courtesy John Bing, A. P. Green Fire Brick Co.)

Various types of talent were pooled to make the November 14th meeting, held by the Northern Illinois-Southern Wisconsin Chapter at the Svea Soner Club in Rockford, an outstanding success. "Shots" of the activities show (1) Joe Deil's Trio giving popular musical renditions; (2, left to right) principals of the evening—J. R. Cochran, Sundstrand Machine Tool Co., Rockford; Chapter Chairman R. W. Mattison, Mattison Machine Works, Rockford; Guest Speaker Jas. A. Murphy, Jas. A. Murphy & Co., Hamilton, Ohio, and H. W. Miner, chapter secretary, Fairbanks Morse & Co., Beloit, Wis.; (3) Svea Soner quartet; (4) gourmets A. G. Anderson, W. L. Davey Pump Co., Rockford, Pinky Walen, and O. W. Josephson, S. Obermayer Co., Chicago, sample some delicacies.

75 Attend Regular No. Ill.-So. Wis. Meeting

By R. W. Mattison

ON November 14 the Northern Illinois and Southern Wisconsin Chapter held its regular meeting at the Svea Söner Club in Rockford, Illinois.

Those responsible for the novel meeting and excellent "lobster tail"

Chapter Chairman Robert Latham (1), Bethlehem Steel Co., Bethlehem, Pa., presided at the November 10 meeting, held by the Philadelphia group at the Engineer's Club, when Norman Tisdale (2), Molybdenum Corp. of America, Pittsburgh, was the principal speaker; B. A. Miller (3), Cramp Brass & Iron Founders Div., Baldwin Locomotive Works, Eddystone, Pa., served as Technical Chairman.

dinner, with all the trimmings necessary to make it perfect, were Gunnard Anderson and O. W. Josephson. Serving as able assistants and cooks were Elmer Strand and "Pinky" Wallin, members of the Svea Söner Club.

The 75 members and guests present were entertained by the Svea Söner Quartet, with music provided by the Joe Deil Trio.

Jas. A. Murphy, Jas. A. Murphy & Co., Hamilton, Ohio, concluded the program with a discussion of "Compressed Air, Its Troubles and Its Remedies."

Philadelphia Studies the Effects of Boron

By B. A. Miller

THE regular monthly meeting of the Philadelphia Chapter was held at the Engineer's Club, Philadelphia, November 10, with Chapter Chairman Robert Latham, Bethlehem Steel Co., Bethlehem, Pa., presiding.

Norman F. Tisdale, Molybdenum Corp. of America, spoke to the 80 members and guests about "Boron in the Foundry Industry." The speaker presented slides showing the effect of small percentages of boron on steel as well as the noticeable results of calcium boride in the deoxidation of copper-base alloys. Mr. Tisdale also demonstrated the effect of boron in cast iron.

National Officers Are Twin City Guests

By Alexis Caswell

THE Twin City Chapter's regular meeting, held November 28, at the Leamington Hotel, Minneapolis, was designated as National Officers' Night. Chapter Chairman A. M. Fulton, Northern Malleable Iron Co., St. Paul, introduced National Director S. V. Wood, Minneapolis Electric Steel Castings Co., who in turn introduced the following National Officers:

President Ralph J. Teetor, Cadillac Malleable Iron Co., Cadillac, Mich.

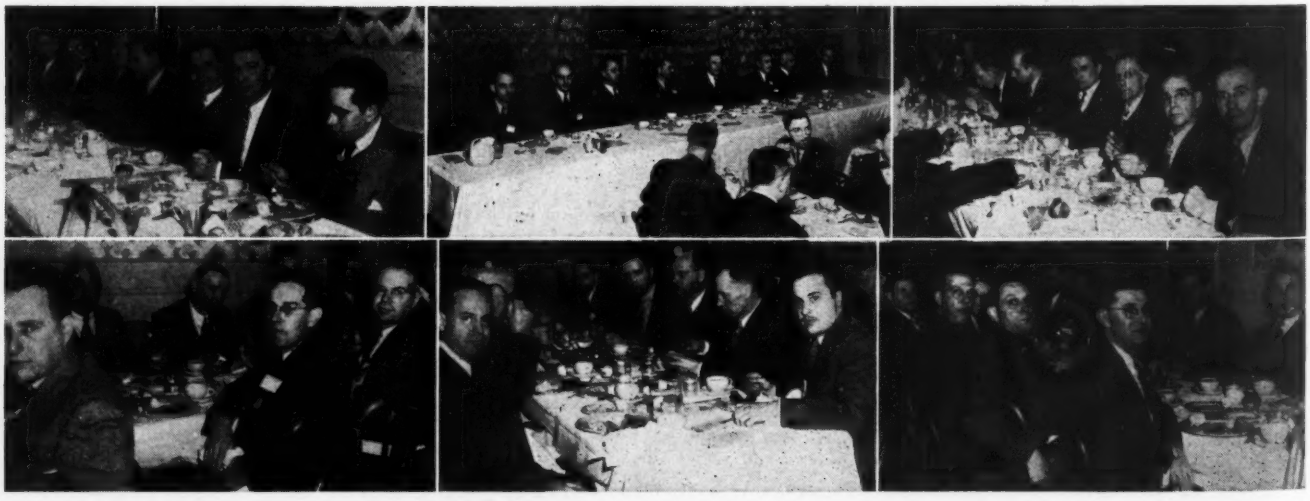
Vice President Fred J. Walls, International Nickel Co., Detroit.

Director Herbert S. Simpson, National Engineering Co., Chicago.

Secretary Robert E. Kennedy, A.F.A. Office, Chicago.

Jas. H. Lansing, Malleable Founders Society, Cleveland, was the technical speaker, and chose for his topic, "Malleable Iron as an Engineering Material." Slides were used during the presentation which was comprehensive and evoked considerable discussion from the 110 members and guests present.

Sheldon P. Pufahl, Paul Pufahl &



Completion of the petition to become the 29th A. F. A. Chapter highlighted the activities of the Central Ohio group meeting on November 21 at the Fort Hayes Hotel, Columbus.

Son Foundry Co., Minneapolis, Chairman of the Membership Committee, reported that 78 new members, including one sustaining and nine company members, had been admitted to the chapter since May 25, 1944.

Toledo Chapter Meeting Features Core Blowing

By G. W. Buchanan

FIFTY members and guests were present at the November 28 meeting of the Toledo Chapter, held at the Oilley Club, Toledo, to hear F. Leon Miller, Osborn Manufacturing Co., Cleveland. Mr. Miller, who was introduced by G. R. Rusk, Freeman Supply Co., Toledo, selected "Core Blowing and Core Blowing Equipment" as his topic and used slides for illustration.

The speaker cited several examples where core blowing had increased production, and mentioned the following pitfalls which are normally encountered in core blowing: insufficient vents in the core box which prevent the air from escaping, thus cutting down the velocity of the sand, and too much moisture which causes the sand to stick in the boxes.

The speaker pointed out that, in general, most vents should be placed in the top of the core box, although each job presents its own problems. Also, the size of the sand ports mainly determines the velocity of the sand entering the core box.

Dr. Jas. S. Vanick Is Birmingham Speaker

By J. P. McClendon

BIRMINGHAM foundrymen enjoyed another treat at the December meeting, when Dr. Jas. T. MacKenzie, Chapter Program Chairman, presented Dr. Jas. S. Vanick, International Nickel Co., New York, as speaker.

Dr. Vanick's subject was "High Temperature Application of Cast Iron." He outlined the history of the work, leading up to the adoption of codes which set the maximum temperature for applications of cast iron at 450 degrees F.

He then described the recent work done by A.S.T.M. Committee A-3 in developing a new proposed specification for gray iron for elevated (up to 650 degrees F.) pressure containing vessels. A new limitation on the composition of the cast iron for elevated temperature work is proposed by defining the carbon equivalent, namely C plus .3 (Si plus P) shall not exceed 3.8. Cast irons above the No. 40 grade are to be eligible for this service.

Series of slides were shown to illustrate the composition and heat treatment of cast irons which exhibited suitable tensile creep, growth and scaling properties at elevated temperatures to meet the requirements of the proposed specification. He also showed some existing applications such as brake drums, autoclaves, melting pots, etc.

Joe T. Gilbert, Stockham Pipe Fittings Co., Birmingham, Chapter Chairman, presided over the dinner and technical session which was attended by over 50 members and friends of the chapter. The meeting, as usual, was held at the Tutwiler Hotel, Birmingham.

VETERANS OF INDUSTRY

Feted at Chicago Old Timers' Night

ON TUESDAY, December 5, the Chicago Chapter honored as its guests 54 men of the industry, each of whom had a record of 50 years or more service in the foundry. The longest term of service was 72 years and the shortest 50.

The program was staged in the Terrace Casino, Morrison Hotel, Chicago, by a committee under the chairmanship of C. P. Wright, American Brake Shoe Co., Chicago. A canvass of the district indicated that a minimum of 100 men in the area had served 50 years or more in the industry, representing, if placed end to end, over 5,200 years.

On opening the occasion, the Chairman gave an interesting and inspirational talk on what had occurred in the industry in the past 5,200 years and, particularly, the progress made in the past 50 years, or during the lifetime of many of those present.

Chapter Vice-Chairman J. C. Gore, Werner G. Smith Co., Chicago, presented each of the Old Timers with an especially designed A.F.A. emblem button, on which was recorded the fact that they had served the industry for 50 years.

Those present then witnessed an extremely fine floor show, which was acclaimed to be the best ever staged by the Chicago Chapter at any of its events. The committee in charge of this, the first Old Timers' Night staged by the Chicago Chapter, was as follows:

C. P. Wright, Chairman, American Brake Shoe Co.
T. J. Magnuson, Co-Chairman, J. S. McCormick Co.
W. H. Parker, Co-Chairman, Continental Foundry & Mach. Co.
G. E. Cramer, American Manganese Steel Div., American Brake Shoe Co.
W. C. Cureton, W. A. Jones Foundry & Machine Co.
R. Frazier, Hansell-Elcock Co.
J. C. Gore, Werner G. Smith Co.
J. Johnson, Jr., Tarrant Foundry Co.
A. V. Magnuson, Champion Foundry & Machine Co.
P. Mate, Greenlee Foundry Co.
L. C. Smith, Peninsular Grinding Wheel Co.
H. J. Sprecken, Sr., International Harvester Co.
A. N. Wallin, S. Obermayer Co.
F. E. Wartgow, American Steel Foundries.
J. H. Owen, Harbison-Walker Refractories Co.

The Old Timers whose names appeared on the program as honored guests were as follows:

Steve Abens, Love Brothers, Inc.
Claus Bahr, Illinois Malleable Iron Co.
Frederick W. Bauer, Bauer-Wilson & Bateman.
Fred Bengsch, Industrial Pattern Works.
John H. Bittner, Chicago Hardware Foundry Co.
James Blood, Illinois Malleable Iron Co.
James Boeinsky, Lindahl Foundry Div., American Gear & Mfg. Co.
Edwin Bowman, Batavia Metal Products, Inc.
Adolph Brauer, Western Foundry Co.
James Brown, International Molders Union of America.
P. J. Bussey, Elizabeth St. Foundry Co.
Daniel Campbell, Frederic B. Stevens Co.
Edw. F. Casey, Sloan Valve Co.
Frank Cederwell, Mid City Foundry Co.
William Chilik, Semi-Steel Test Foundry.
Albert Christenson, Christenson & Olsen Foundry Co.
Louis T. Cook, Continental Fdry. & Machine Co.
William H. Cramer, American Manganese Steel Div.
Axel Dahlberg, Mid-City Foundry Co.
Lennart Dahlberg, Mid City Foundry Co.
Alex Dapogny, Foundry Exhibit, Museum of Science & Industry.
H. L. Demmler, Wm. Demmler & Bros.
C. Dewar, Hansell-Elcock Co.
John J. Dix, Superior Aluminum Foundry Co.
Otto Dodt, National Malleable & Steel Castings Co.
Geo. F. Dolan, Calumet Brass Foundry.
John Duffy, American Steel Foundries.
F. Eberhard, Hansell-Elcock Co.
Charles Erickson, Elizabeth St. Foundry Co.
Edward Ericson, Nichol Straight Foundry.
Gus Erlandson, Pettibone Mulliken Corp.
Clarence E. Estes, American Manganese Steel Div.
Charles H. Faitz, National Malleable & Steel Castings Co.
Andrew Fleming, National Malleable & Steel Castings Co.
Jack Fogarty, Mt. Vernon Car Mfg. Co.
Howard Fristoe, Atlas Foundry.
W. K. Fritzie, Eddy Iron Foundry Co.
Frank Gizewski, National Malleable & Steel Castings Co.
Samuel Griffif, Illinois Malleable Iron Co.
Alexel Gustafson, Chicago Hardware Foundry Co.
Carl Hammerberg, Noonan-Mahlstrom Foundry Co.
John Harneck, Link-Belt Co.
Jim Hecht, Louis Meskan Brass Foundry.

O. W. Hedstrom, O. W. Hedstrom Corp.
William Hennings, Industrial Pattern Works.
Henry Hoffman, Major Foundry Co.
Walter W. Hughes, Herman Pneumatic Machine Co.
Oscar Hultgran, Calumet Brass Foundry.
Fred James, Sivyer Steel Casting Co.
Charles Johnson, Sheffield Foundry Co.
John Johnson, Sr., Tarrant Foundry Co.
William G. Jones, R. Lavin & Sons.
Joseph Junio, Sheffield Foundry Co.
Charles C. Kawin, Charles C. Kawin Co.
Wm. L. King, American Steel Foundries.
Frank Kodl, Brucker Foundry Co.
Frank Koepke, Hansell-Elcock Co.
Joe Kozlowske, Carnegie Illinois Steel Corp.
Max Krampel, Artz Foundry Co.
Frank Krause, Howard Foundry Co.
Fred Lantz, Continental Foundry & Machine Co.
Fred Larson, Elizabeth St. Foundry Co.
Gust Larson, Elizabeth St. Foundry Co.
J. T. Llewellyn, Chicago Malleable Steel Castings Co.
Guy E. Lund, Chas. A. Krause Milling Co.
Paul Mantzke, Love Brothers, Inc.
Peter Mate, Greenlee Foundry Co.
James McFarlane, Ferguson and Lange Foundry Co.
Wm. Mountain, Semi-Steel Test Foundry Co.
Albert Nelson, American Brake Shoe Co.
James O'Brien, Semi-Steel Test Foundry Co.
Geo. O'Connor, Link-Belt Co.
Louis Olsen, Vulcan Iron Works.
G. Olson, National Founders' Assn.
Alfred Palm, Elizabeth St. Foundry Co.
August Pantel, Artz Foundry Co.
Joseph Papineau, Howard Foundry Co.
Henry Patnoude, Brucker Foundry Co.
E. Pernsot, Hansell-Elcock Co.
John Peterson, Mid-City Foundry Co.
M. J. Powers, J. S. McCormick Co.
John Rank, Vulcan Iron Works.
Geo. J. Reeling, Illinois Malleable Iron Co.
Julius Ringham, Noonan-Mahlstrom Foundry Co.
Michael Rose, Lindahl Foundry Div., American Gear & Mfg. Co.
G. A. Schultz, Tilden Tech. High School.
David Short, Howard Foundry Co.
H. G. Shumway, C. W. Shumway & Sons.
John Skonie, Artz Foundry Co.
Otto Sonnenburg, Illinois Malleable Iron Co.
Joseph Spirk, National Malleable & Steel Castings Co.
Peter Swanson, Ferguson and Lange Foundry Co.
Thomas S. Taylor, Whiting Corp.
Oscar F. Turnell, American Steel Foundries.
Frank Vajner, Greenlee Foundry Co.
Joseph Vasick, Howard Foundry Co.
August Vick, Illinois Malleable Iron Co.
A. Walcher, American Steel Foundries.
W. E. Watters, National Malleable & Steel Castings Co.
Towner K. Webster, Hydro-Blast Corp.
L. C. J. Weckerley, Ferguson and Lange Foundry Co.
Charles Wedell, Greenlee Foundry Co.
C. P. Widdicombe, Sivyer Steel Casting Co.
Herman Wilke, C. H. Milles Foundry Co.
J. C. Wiman, Artz Foundry Co.

Chicago's Old Timer Pin which was presented to those with 50 years of foundry service.

Northern California Meets in Oakland

By Richard Vosbrink

VICE-PRESIDENT A. J. Snow, Snow & Galgiani, San Francisco, presided at the Northern California Chapter's December 8 meeting, held at Angelo's in Oakland.

Two motion pictures—"The Birth of the B-29" and films of the group's 1938 and 1944 golf outings—contributed to the evening's entertainment. The first picture was a thought provoking and illuminating disclosure of the expensive and technically difficult problem of developing and coordinating modern air warfare, while the second film gave the group an opportunity to view themselves as others see them.

W. G. Frank, American Air Filter Co., provided the technical talk of the evening. His subject revolved around problems encountered in removing dust and other unhygienic gases, fumes, etc., from industrial plants. Mr. Frank illustrated his talk with pictorial slides.

First Roundtable Meeting Held by Canton District

By Nils E. Moore

DISCUSSION sessions on four different topics were held for the first time by the Canton District Chapter, November 30, at the Elks Club, Canton, Ohio.

The subject of iron was directed by Earl Brown, Union Metal Mfg. Co., Canton; Charles Reyman, Jr., Atlantic Foundries Co., Akron, led the discussion of steel; the brass and bronze section was headed by Charles Bunting, Pitcairn Co., Barberton; and H. C. Robertson, American Steel Foundries, Alliance, served as the leader for the foundry maintenance session.

This group treatment of individual problems was so well received by the 71 members and guests attending the meeting that the hope was expressed for similar programs to follow.

Preceding the roundtable sessions, Chapter Chairman K. F. Schmidt, United Engineering & Foundry Co., Canton, presided at a general meeting and dinner. G. F. Malick, Vocational Director of the Timken High School, Canton, the guest speaker, discussed "The Apprentice Problem," and pointed out ways in which the foundry trade can be made more attractive to prospective apprentices. He also discussed the boys' reaction to job training.

Personalities at the Chicago Chapter's Old Timers' Night, held at the Terrace Casino, Chicago, on December 5.

Abstracts

NOTE: The following references to articles dealing with the many phases of the foundry industry, have been prepared by the staff of *American Foundryman*, from current technical and trade publications.

When copies of the complete articles are desired, photostat copies may be obtained from the Engineering Societies Library, 29 W. 39th St., New York, N. Y.

Aluminum-Base Alloys

CASTINGS DESIGN. *"Designing Aluminum Sand Castings,"* R. Irmann, LIGHT METAL AGE, October, 1944, vol. 2, no. 6, pp. 18-22.

A Swiss article translated by Enfield Rolling Mills, Ltd., England.

The author lists some of the principles which must be observed in designing aluminum-base castings and supplies numerous drawings to illustrate good and bad design.

Casting Methods

CENTRIFUGAL. *(See Centrifugal Casting.)*

Centrifugal Casting

STEEL. *"High-Strength Centrifugal Castings,"* Stanley P. Perry, THE IRON AGE, October 5, 1944, pp. 52-53.

The author describes research work which produced centrifugally cast steel having a tensile strength of 180,000 psi. and a ductility of 10 per cent.

Fatigue Properties

SURFACE TREATMENT. SHOT PEENING. Published by American Foundry Equipment Co., Mishawaka, Indiana, 1944, 74 pp., $1.50.

This book presents and discusses the theoretical and practical aspects of shot peening. The technical principles are discussed in a paper by H. F. Moore, entitled "Shot Peening and the Fatigue of Metals." This paper is reproduced in Chapter 3 of the book.

Other chapters deal with such subjects as what is shot peening and its effect, what benefits are to be derived from shot peening, applications and technique of shot peening, and shot peening equipment.

Heat Treating

FIXTURES. *"Special Loading Fixtures Add to a Furnace Capacity and Operating Economy,"* Paul Goetcheus, INDUSTRIAL HEATING, October, 1944, vol. 11, no. 10, pp. 1639-1640, 1642, 1644, 1646.

The author describes various fixtures of heat resisting alloys which may be used during heating and heat treating to handle metal parts in a more economical manner.

Gypsum Cement

PATTERNS. *(See Pattern Making.)*

Heat Treatment

STEEL. *(See Steel.)*

Magnesium-Base Alloys

SECONDARY METAL. *"Use of Secondary Magnesium in Foundries,"* W. E. Martin, ALUMINUM AND MAGNESIUM, October, 1944, vol. 1, no. 1, pp. 34-35.

Secondary magnesium may safely be used in foundries provided the fluxing operation is thoroughly and carefully performed. Attention must be given to scrap segregation, since some elements are not lost from the metal during remelting and others build up in normal foundry operation. Aluminum, iron, and manganese are removed in the sludge, and manganese may have to be replaced. Copper and nickel are not lost and care must be taken to see that they are held to specified values. Silicon is picked up from sand, particularly if scrap is not well cleaned before remelting. Tin and lead are not difficult to control.

Metallurgy

EQUILIBRIUM DIAGRAMS. *"The Equilibrium Diagram of the System Copper-Zinc,"* G. V. Raynor, Annotated Equilibrium Diagram Series, No. 3, The Institute of Metals, September, 1944, 6 pp.

A diagram of the copper-zinc system, a tabulation of all important data connected with the diagram, a number of critical notes, and a list of references.

EQUILIBRIUM DIAGRAMS. *"The Equilibrium Diagram of the System Copper-Tin,"* G. V. Raynor, Annotated Equilibrium Diagram Series, No. 2, The Institute of Metals, September, 1944, 6 pp.

A diagram of the copper-tin system, a tabulation of all important data in connection with the diagram, a number of critical notes, and a list of references.

SEGREGATION. *"Symposium on Segregation,"* T. P. 1764, METALS TECHNOLOGY, September, 1944, vol. 11, no. 6, 88 pp.

A compilation of articles on segregation in various alloys. Articles in the symposium are: "Fundamental Principles Involved in Segregation in Alloy Castings," by R. M. Brick; "Review of Factors Underlying Segregation in Steel Ingots," by B. M. Larsen; "Introduction to Session on Segregation in Steel," by Earle C. Smith; "Relation of Open-Hearth Practice to Segregation in Rimmed Steel," by J. W. Halley and G. L. Plimpton, Jr.; "Segregation in a Large Alloy-Steel Ingot," by S. W. Poole and J. A. Rosa; and "Segregation in Babbitt," by T. E. Eagan and W. R. McCrackin.

Non-Destructive Testing

ALUMINUM-BASE ALLOYS. *(See Radiography.)*

Ovens

CORE. *"Core Ovens in the Aircraft Engine Industry,"* H. E. Linsley, INDUSTRIAL HEATING, October, 1944, vol. 11, no. 10, pp. 1717-1718, 1720, 1722, 1724, 1726, 1730, 1732, 1734, 1736, 1738.

A detailed description of the oven installations in a foundry producing aircraft castings.

Pattern Making

PLASTER PATTERNS. *"Patterns of Gypsum Cement,"* E. H. Schleede, THE FOUNDRY, October, 1944, vol. 72, no. 10, pp. 76-77, 224, 226, 228; November, 1944, vol. 72, no. 11, pp. 90-91, 186, 188, 190, 192, 194.

This article describes the behavior of plaster mixes and the manner in which plaster of Paris may be used to make patterns and models. The tools, equipment, and five forming methods are described.

Pouring Practice

STEEL. *"Steel Foundry Pouring Practice,"* John Howe Hall, THE FOUNDRY, October, 1944, vol. 72, no. 10, pp. 74-75, 210, 212, 214, 216, 218.

Certain characteristics of molten steel make it undesirable to pour steel using the plain lip-poured ladle commonly found in gray iron foundries. The melting point of steel is high, the metal is sluggish at temperatures just above the melting point, and removing the greater part of the surface slag would permit undue cooling of the metal. Furthermore, steel runs in a wide stream which often makes the pouring of steel castings somewhat more difficult than the pouring of gray iron castings. Large steel castings are commonly poured with a bottom-pour ladle while a teapot ladle may be used for smaller castings. Pro-

vision is made to hold back the slag while pouring the metal.

Considerable care should be given to the proper selection of nozzles and stoppers for bottom-pour ladles. Nozzles should be of the proper size and of the correct hardness. Stopper heads should be fitted to the nozzle. Stopper rods should be adequately protected from the molten metal and should be assembled in such a way as to prevent breakage as the result of expansion.

Radiography

ALUMINUM-BASE CASTINGS. *"Development of a Monochromatic Radiographic Method for Locating Small Defects in Aluminum Alloy Castings,"* George L. Clark and R. W. Eyler, INDUSTRIAL RADIOGRAPHY, Summer, 1944, vol. 3, no. 1, pp. 13-18.

The author briefly reviews the history of radiography, the theoretical aspects of radiographic inspection, and then describes the development of the radiographic technique for the inspection of an aircraft casting.

Refractories

ELECTRIC FURNACE. *(See Steel.)*

LADLE. *"X-ray Inspection Reveals Stopper Head Defects,"* Clyde B. Jenni, STEEL, October 16, 1944, vol. 115, no. 16, p. 104.

The condition of stopper heads used in steel pouring ladles is of considerable importance. The inspection of stopper heads by the use of long wave-length, low power x-rays with short exposures reveals many defects which would be responsible for unsatisfactory service if the defective stopper head were used.

Experience will enable the inspector to judge the degree of defect which will bar a stopper head from successful use.

P.C.E. TEST. *"Significance of the Pyrometric Cone Equivalent Test of Refractories and Refractory Raw Materials,"* Robert B. Sosman, CERAMIC ABSTRACTS AND THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY, October 15, 1944, vol. 23, no. 10, pp. 367-370.

The pyrometric cone equivalent test is not a temperature measurement. It is a test of similitude in thermal behavior between a standardized and an unknown refractory. By proper care of conditions of heating it can be made reproducible within one cone number for clays and fire-clay refractories. It gives quick and easily acquired indications concerning flow of the refractory under light load at high temperature, but should be supplemented by the regular hot-load and other tests.

SPALLING. *"Significance of the Panel Spalling Test,"* L. C. Hewitt, CERAMIC ABSTRACTS AND THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY, October 15, 1944, vol. 23, no. 10, pp. 372-373.

The panel spalling test for fire-clay brick is simulative to service owing to the fact that one face of the furnace wall is exposed to the test conditions. The test correlates the effect of such factors as refractoriness, volume stability, structure, modulus of elasticity, and thermal expansion with the ability of a firebrick to withstand thermal shock. The panel spalling test is used with a high degree of success in controlling and developing refractories to meet service needs.

Steel

CENTRIFUGAL CASTINGS. *(See Centrifugal Casting.)*

ELECTRIC FURNACE. *"Acid Electric Steel-Making Practice,"* Conrad C. Wissmann, METAL PROGRESS, October, 1944, vol. 46, no. 4, pp. 723-726.

The author says of this article, "It is my intention to write a simple set of instructions primarily as an aid to those who are engaged in the operation of acid electric steel-melting furnaces. All of the problems discussed herein will have to do with the *operation* of the furnace and the *process* of steel making. It is not written for owners of plants or those who are thinking about installing an electric furnace."

Problems discussed in this article are charging the furnace, making contact, pulling bottom, and scrap bridging.

ELECTRIC FURNACE. *"Electric Furnace Operators Debate Production Problems,"* THE IRON AGE, October 19, 1944, vol. 154, no. 16, pp. 68-73.

A report of the second annual conference on electric furnace steel, sponsored by the Electric Furnace Committee of the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers.

The report includes the following: "Factors Affecting Roof Life and Lining of Electric Furnaces," "Construction Methods for Side Walls and Bottoms of Basic Furnaces," and "Chromium Loss and Recovery, and Control of Residual Chromium."

HEAT TREATMENT. *"Facilities for Water Quenching Steel Castings,"* R. H. Swartz, THE FOUNDRY, October, 1944, vol. 72, no. 10, pp. 82-84, 230, 232, 234, 236.

Only recently industry has begun to recognize the gains to be had from water quenched steel castings. Consequently they are giving attention to the factors which must be considered in water quenching—type of steel, furnace equipment, and quenching facilities. The last factor is of considerable importance.

Types of quenching equipment may be divided into three groups: batch, semicontinuous, and continuous quenching equipment. These terms are more or less descriptive of the manner in which castings are introduced into, moved through, and removed from the quenching bath. The author gives a detailed description of these types of equipment.

LADLES. *(See Pouring Practice.)*

PROPERTIES. *"The Influence of Melting Conditions on the Physical Properties of Steel Castings,"* H. T. Protheroe, Advance Copy, THE IRON AND STEEL INSTITUTE, August, 1944, Paper No. 11/1944 of the Steel Castings Research Committee, 23 pages.

This paper gives a detailed report on the mechanical-test results obtained from a number of cast steels from various sources. A critical examination of the data recorded during manufacture has been made and used in conjunction with mechanical-test results in an attempt to trace the factor or factors having the most pronounced influence on the quality of cast steel.

It appears that the combined phosphorus and sulphur percentage affect the mechanical properties to a much greater extent than do other factors, such as casting temperature, etc., and the property most affected is the impact value.

Unsoundness, as indicated by blowholes or porosity, also has a pronounced effect, particularly on the ductility properties as measured by the reduction of area and elongation. Its effect on the tensile properties depends to a large extent on the actual location of the defect in the test-piece.

There is an indication that the casting temperature, under controlled conditions, may have a slight effect on the mechanical properties. Its influence is so weak, however, that, unless the effect of other factors is completely eliminated, it is not noticed.

The microstructures of the cast steels do not differ appreciably, and give no indication of the mechanical properties to be expected. The differences in macrostructures, however, are quite distinctive, and an explanation for the variations is put forward. The macrostructure itself does not indicate what mechanical properties are to be expected from the steel.

The influence of other factors, such as the nature and distribution of inclusions, grain size and the method of manufacture, etc., has also been considered, but cannot be definitely correlated with the mechanical properties.

YIELD STRESS. *"Relationship of Brinell Hardness and Yield Stress,"* T. W. Ruffle, THE IRON AGE, September 28, 1944, vol. 154, no. 13, pp. 50-53.

The author presents data to show that it is possible to estimate the yield stress of a steel from its Brinell hardness number. However, it should be noted that his data apply only to the particular type of steel which he used in his consideration of the relationship. Any other type of steel or steel which had been differently heat treated would have to be completely analyzed before similar formulas could be set up.

Testing

NON-DESTRUCTIVE. *"Fluorescent Penetrant Inspection,"* Greer Ellis, STEEL, October 16, 1944, vol. 115, no. 16, pp. 100-102, 164.

By means of fluorescent penetrant inspection, flaws in metal parts are detected by permitting a fluorescent substance to penetrate cracks or porous defects, removing the fluorescent substance from the surface of the part, and then examining the part under near ultraviolet light. Any imperfections which extend to the surface will then show as glowing indications.

Tinning

CAST IRON. *"Tinning Cast Iron for Babbitted Bearings,"* T. E. Eagan, METALS AND ALLOYS, September, 1944, vol. 20, no. 3, pp. 625-629.

The author describes a process for cleaning cast iron surfaces prior to tinning or babbitting. Formerly the graphite which spread over a machined surface of cast iron prevented the formation of a good bond. In this process, the graphite is oxidized along with the surface metal. The carbon dioxide combines with the alkaline oxidizing bath. An acid bath removes the oxidized metal and leaves a chemically cleaned surface for bonding. This process has eliminated the need for anchor grooves in babbit cast-iron-backed bearings.

Schedule of January Chapter Meetings

January 2
Chicago
Chicago Bar Ass'n Restaurant
ROUNDTABLE MEETING
Steel—*"Acid Electric Melting"*
Gray Iron—*"Gating and Risering"*
Non-Ferrous & Pattern Div.—
"Non-Ferrous Patterns"
Malleable—*"Furnace Operation and Melting Problems"*

✦ ✦

January 4
Saginaw Valley
Fisher's Hotel, Frankenmuth, Mich.
C. E. BALES
Ironton Firebrick Co.
"New Developments in Foundry Refractories"

✦ ✦

January 8
Central Indiana
Athenaeum, Indianapolis
NATIONAL OFFICERS' NIGHT

✦

Cincinnati
Engineering Club of Cincinnati
NATHAN JANCO
Centrifugal Casting Machine Co.
"Centrifugal Casting Methods"

✦

Metropolitan
2 Park Ave., New York City
Joint Meeting with A.S.M., A.W.S.
N. L. MOCHEL
Westinghouse Electric Co.
"Shall It Be Cast, Welded or Forged?"

✦

Western Michigan
Ferry Hotel, Grand Haven, Mich.

✦

Michiana
ROUNDTABLE MEETING
"Molding Methods & Equipment"

✦

No. Ill.-So. Wis.
Hotel Hilton, Beloit, Wis.

✦

Quad City
Fort Armstrong Hotel,
Rock Island, Ill.
AL DEMMLER
C. W. C. Foundry
"Inherent Characteristics of Iron and Steel"

✦ ✦

January 11
Canton District
Elks Club, Canton
FRED G. SEFING
International Nickel Co.
"Study of Molding Methods for Sound Castings"

Northeastern Ohio
Cleveland Club, Cleveland
H. G. DYKTOR
Bureau of Industrial Hygiene
Equipment Manufacturers Ass'n
Program

✦

St. Louis
DeSoto Hotel
E. E. WOODLIFF
Foundry Sand Service Co.
"Foundry Sand"

✦

Texas
Beaumont, Texas

✦ ✦

January 12
Birmingham
Tutwiler Hotel, Birmingham
NATHAN JANCO
Centrifugal Casting Machine Co.
"Centrifugal Casting Methods"

✦

Central New York
Onondaga Hotel, Syracuse
WILLIAM ROMANOFF
H. Kramer & Co.
"Non-Ferrous Foundry Practice Metallurgy"

✦

Northern California
Engineers Club, San Francisco
ROUNDTABLE MEETING
Iron, Steel, Non-Ferrous and Patterns

✦

Philadelphia
Engineers Club of Philadelphia
D. FRANK O'CONNOR
American Saw Mill Machinery Co.
BRASS FOUNDRY FORUM

✦

Rochester
Hotel Senaca, Rochester
NATIONAL OFFICERS' NIGHT

✦

Wisconsin
Schroeder Hotel, Milwaukee

✦ ✦

December 13
Western New York
Elks Club, Buffalo
ANNUAL STAG

✦ ✦

January 18
Detroit
Rackham Educational Memorial,
Detroit
J. E. LINABURY
General Motors Corp.
"Planning the Foundry of Tomorrow"

January 19
Eastern Canada and Newfoundland
Mount Royal Hotel, Montreal
A. H. WILLIAMS
Canadian Car Wheel Co.
"Apprentice Training"

✦ ✦

January 22
Chesapeake
Engineers Club, Baltimore
ROUNDTABLE MEETING

✦ ✦

January 25
Twin City
M. E. BROOKS
Dow Chemical Co.
"Production of Magnesium Castings"

✦ ✦

January 26
Ontario
Royal Connaught Hotel, Hamilton
J. A. GITZEN
Delta Oil Products
"Cores"

✦ ✦

January 30
Toledo
"Oilley's," Toledo

✦ ✦

FEBRUARY MEETINGS

February 1
Saginaw Valley
Fisher's Hotel, Frankenmuth, Mich.
A. L. BOEGEHOLD
General Motors Corp.
"Modern Cast Iron"

✦ ✦

February 5
Central Indiana
Athenaeum, Indianapolis
"Casting Design"

✦

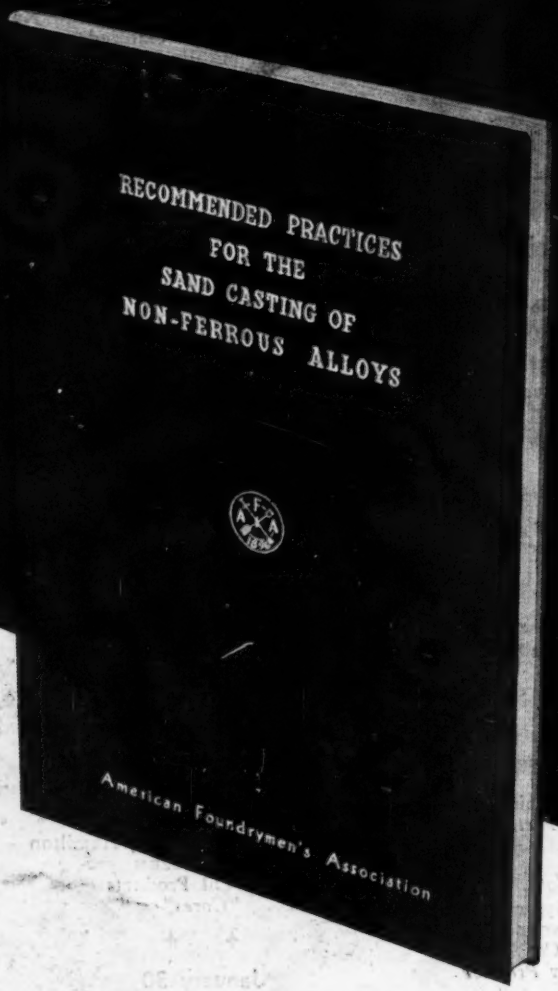
Chicago
Chicago Bar Ass'n Resturant
"Job Evaluation & Time Study"

✦

Metropolitan
Essex House, Newark, N. J.
ROUNDTABLE MEETING
"Gating & Risering"

✦ ✦

February 6
Michiana
N. J. DUNBECK
Eastern Clay Products
"Synthetic Foundry Sands"



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Tin Bronze and Leaded Tin Bronze.
High-Lead Tin Bronze.
Leaded Nickel Brass and Bronze Alloys (Silicon Bronze).
Aluminum Bronze.
Aluminum-Base Alloys.
Magnesium-Base Alloys.